NOVEMBER 2002

ANALOG

SCIENCE FICTION AND FACT

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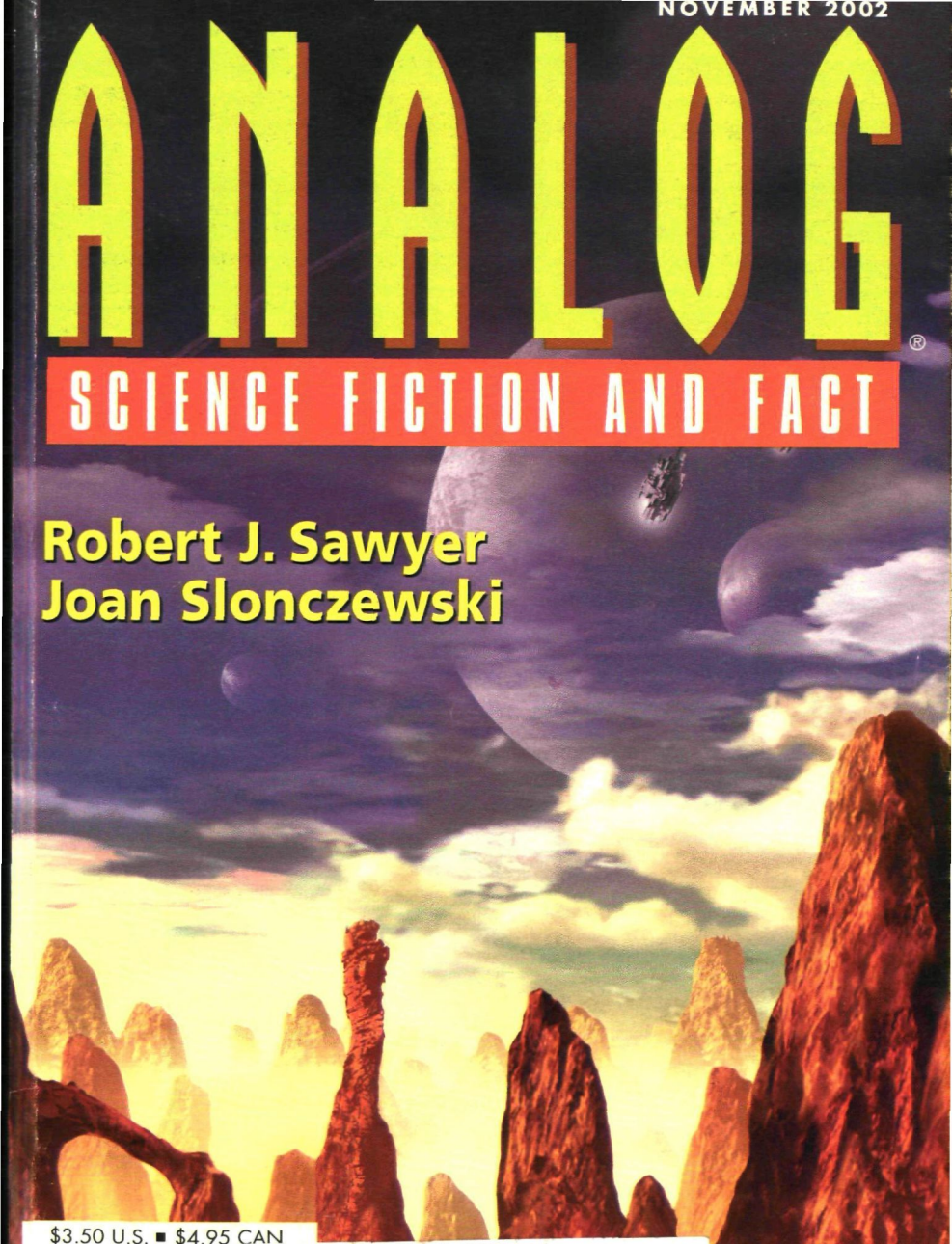

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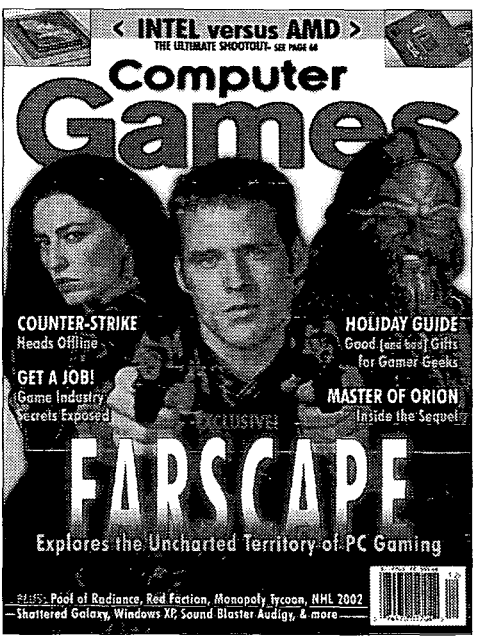

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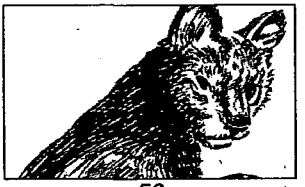

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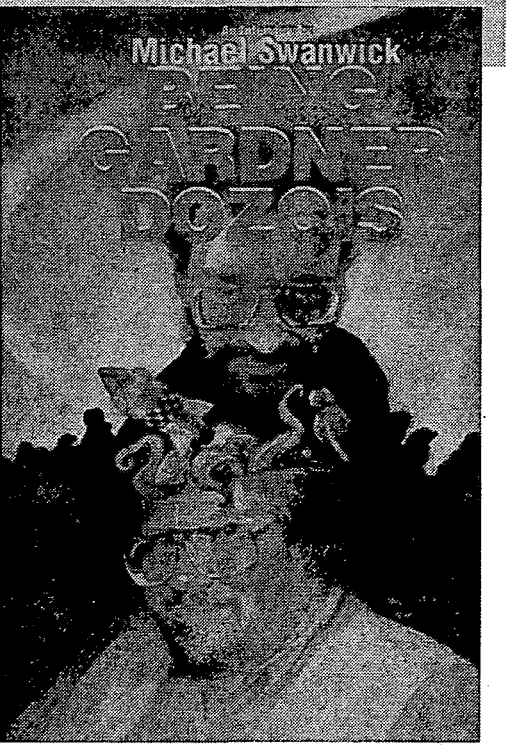

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EDITORIAL Stanley Schmidt

TO DESCRIBE OR PRESCRIBE

Some years ago, while waiting in the lobby of a major concert hall before the concert began, I overheard a young woman call out to her companion, "Oh, that must be she!"

I turned to *my* companion with a grin and said, "And that must be an English teacher."

Much more recently, over lunch, I mentioned this incident to a couple of colleagues, adding the comment that English teachers teach a language spoken only by English teachers. It isn't as bad as that makes it sound, of course. The language taught in classrooms is close enough to that used by most of the populace outside classrooms to be mutually intelligible. Much of what is taught can, if taken to heart, even enhance the effectiveness of "real-world" communication. But some of it, like the example above, is heard so seldom outside the classroom that I must conclude that while it may belong to a language that used to be spoken, it is *not* the one in common use now—which is determined and defined not by academics, but by a consensus of actual speakers.

"Oh," said one of my lunch companions, "you're a descriptionist rather than a prescriptionist."

"Well, yes and no," I said. "Or maybe I should say up to a point, but only up to a point."

"Descriptionist," in its purest (or most extreme) form, means someone who believes there is no right or wrong in language. English, for example, is the total of what all the people who claim to speak it speak. The job of a linguist or English teacher is simply to describe what *is* done, not to prescribe some choices as better than others.

"Prescriptionist," in its purest (or most extreme) form, means someone who believes speech and writing must follow well-defined rules. The function of a linguist is to determine what those rules are, and the job of an English teacher or editor is to enforce them.

I have known real people who adamantly subscribed to either of those views, but I can accept neither in its pure (or extreme) form—and the question is by no means purely academic. As an editor, I must constantly make decisions about whether and when to ask authors to change what they've written. As a writer, I must make decisions about when to accept and when to dispute such suggestions from other editors. And, as with so many things, I find that the rational course lies somewhere between the extremes. There are writers who think I should accept without question whatever they choose to write, and there are readers who think I should stringently enforce every rule taught by the strictest pedants of sixty or seventy years ago. Both are, in an important sense, wrong.

The key concepts are *consensus* and *evolution*. As I said above, the "real" language of a time and place is determined by a consensus of the people who speak and write it. If you accept the premise that the *raison d'être* of language is as a tool for communication, then consensus

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is its most essential quality. It cannot be used to communicate effectively unless speakers and listeners agree on what a word or a tense ending means, and writers and readers agree on how to spell a word or what the presence or absence of a punctuation mark means.

But the consensus is never absolute or universal, and it shifts with time. Thus, for example, the meanings of "liberal" and "conservative" in current common usage are startlingly close to the opposites of what they were at some times in the past; and even English teachers have largely abandoned their misguided attempts to absolutely forbid splitting infinitives (which seem to have been based on trying to make English conform to rules of Latin, which has a quite different structure).

So to function in the real linguistic world, it's always necessary to decide, in a less than absolute way, what the current consensus is, and (to a point) to insist on careful usage consistent with it. It's simultaneously necessary to recognize that people can and should exert pressures to change that consensus.

This is an uncomfortable position for people who want either total freedom from rules, or complete order and regularity in their lives. This may be regrettable, but the fact is that they can't have either simplistic extreme. We do need rules, as guidelines to insure mutual intelligibility, and we need English teachers to insist that people learn and follow them—unless they have a good, well-defined reason not to. But we also need to recognize that the generally agreed-upon rules *will* change. If 99 percent of the people adopt a consistent way of doing something that the books say is "wrong," then it no longer makes sense to say that the book describes anything meaningful. It needs to be revised, and this will inevitably happen from time to time.

One of the important ways that such changes happen is by writers doing things that violate old rules. If enough others like an innovation and start adopting it themselves, it may eventually become part of a new consensus—to be codified in later (but not permanent or final!) revisions of the "rule books." For that to happen, the writer's new way of doing things must be published—which means it must pass the editorial filter.

Editors can legitimately differ in how much they'll let pass. My personal approach is to buy stories I like well enough to print, and then print them. I am unlikely to like them that well if they simply disregard generally accepted rules of spelling, usage, or punctuation; but I do not do wholesale rewriting of other people's work, or try to homogenize them so they all sound like me. If something bothers me in a manuscript, I'll ask the author why he or she did it, and usually let it go if I get a reasonable explanation. And I do recognize that someone may deliberately try to introduce a new word or construction into

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the language and hope it catches on. For example, I decided early in my editing that the terms "microwriting" and "macrowriting" were useful for describing a pair of concepts I often needed to discuss. I use them freely in my correspondence with writers, and I wouldn't mind at all if they eventually spread beyond that rather small circle.

Of course, not all changes—or present rules—are equally desirable, any more than all opinions about anything are equally valid. I say again, language exists as a tool for communication, and rules—old or new—are "good" or "bad" only insofar as they make it an effective or ineffective tool. I mentioned earlier that I am pleased by the general relaxation of the old "ban" on splitting infinitives, because it was a rule that frequently led to awkwardness rather than clarity. (In the sentence, "They tried to absolutely forbid splitting infinitives," putting "absolutely" anywhere else results in ambiguity, awkwardness, and a decidedly stilted sound.) On the other hand, English has long had a nicely honed set of rules for using commas and hyphens to insure precision of meaning, and now those marks are frequently thrown in or omitted apparently at random. That's a change that seriously undermines one of our language's real strengths, and therefore I resist it as vigorously as possible—both by using commas and hyphens carefully in my own writing, and by expecting writers I edit to do so too.[1]

I realize, though, that I may lose the battle. Much as precise use of commas and hyphens contributes to the value of the language as a tool, if everybody decides to discard the rules for using them, that will be the new shape of the language and my preference for the old way will be irrelevant. The word "decimate" originally meant "to select by lot and kill one in every ten of," but for a modern writer to insist (as some very good ones have done) that that's the *only* way it can or should be used, is to deny real history. We're not speaking Latin, or even nineteenth-century English. We're speaking early twenty-first-century English, and that has long since appropriated "decimate" to mean—in

[1] Please don't bother to write in that you found a couple of errors in this area. We have a small staff, limited time, and we're not infallible—so things we didn't intend do sometimes slip by.

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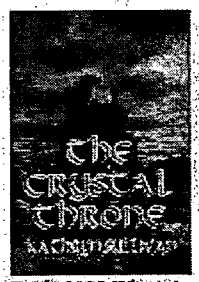

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addition to its original meaning—to exterminate almost completely. That is, in fact, probably now the most generally understood meaning. I agree that it's unfortunate that the word has acquired two such different meanings—it has definitely cost us a precision we once had—but I can't deny that it has happened.

So writers, readers, editors, and English teachers who care about promoting effective communication must balance several somewhat conflicting ideals. Mutual understanding requires that we agree, insofar as possible, on a set of rules for word meanings, syntax, punctuation, etc. This means that we must teach those rules, try to follow them, and expect others to do the same—unless there's a clear and convincing reason to do otherwise. But we must also recognize that sometimes there is such a reason. We must recognize that language itself is a tool that not only will inevitably change with time, but *should* change with time, to meet changing needs and preferences. Sometimes such change can be deliberately promoted or resisted. But not all changes are created equal. In deciding which ones to accept willingly, and which ones to try to fight off, we should be guided by one principle: our language should be the best tool for communication that we can make it. Any tool requires maintenance, and in the case of language that means promoting changes that will let it do its job better, and resisting those that undermine its existing strengths. ■

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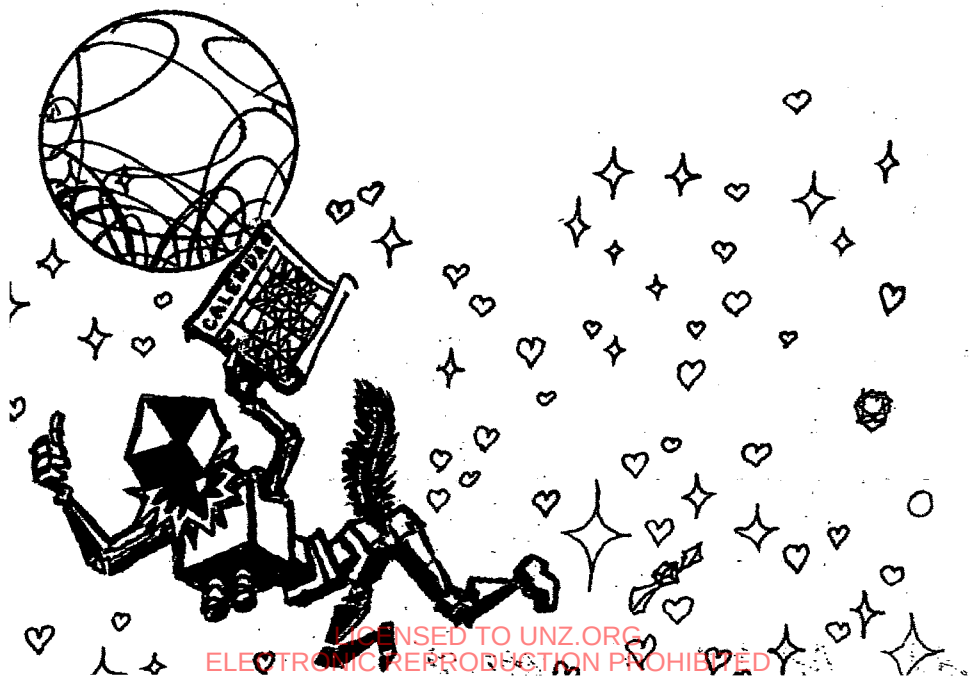
INELUCTABLE

Robert J. Sawyer

Illustration by Kelly Freas

The trouble with communication
is that it rests on assumptions, and you can't tell
how much they're shared until you've
communicated quite a bit.



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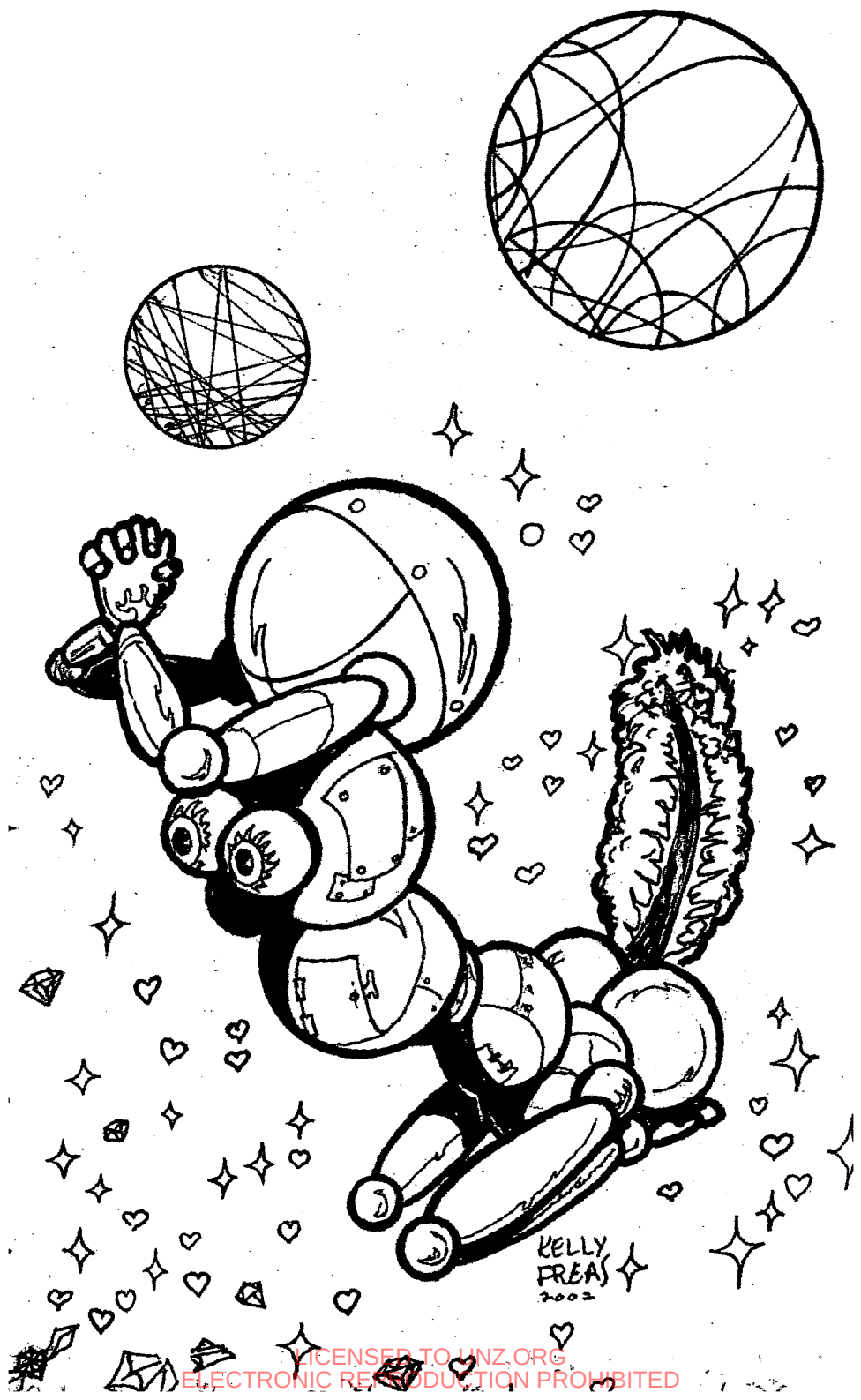

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What to do? What to do?

Darren Hamasaki blew out air, trying to calm down, but his heart kept pounding, a metronome on amphetamines.

This was big. This was huge.

There *had* to be procedures in place. Surely someone had thought this through, had come up with a—a *protocol*, that was the word.

Darren left the observatory shed in his backyard and trudged through the snow. He stepped up onto the wooden deck and entered his house through the sliding-glass rear doors. He hit the light switch, the halogen glow from the torchiere by the desk stinging his dark-adapted eyes.

Darren took off his boots, gloves, tuque, and parka, then crossed the room, sitting down at his computer. He clicked on the Netscape Navigator icon. Oh, he had Microsoft Explorer, too—it had come preinstalled on his Pentium IV—but Darren always favored the underdog. His current search engine of choice, which changed as frequently as the current favorite CD in his stereo, was also an underdog: HotBot. He logged on to it and stared at the dialog box, trying to think of what keywords to type.

Protocol was indeed appropriate, but as for the rest—

He shrugged a little, conceding the magnitude of what he was about to enter. And then he pecked out three more words: *contact*, *extraterrestrial*, and *intelligence*.

He'd expected to have to go spelunking, and, indeed, there were over thirteen hundred hits, but the very first one turned out to be what he was looking for: "Declaration of Principles Concerning Activities Following the Detection of Extraterrestrial Intelligence," a document on the SETI League web site. Darren scanned it, his eyes skittering across the screen like a puck across ice. As he did so, he rolled his index finger back and forth on his mouse's knurled wheel.

"We, the institutions and individuals participating in the search for extraterrestrial intelligence . . ."

Darren frowned. No one had sought his opinion, but, then again, he hadn't actually been *looking* for aliens.

". . . inspired by the profound significance for mankind of detecting evidence . . ."

Seemed to Darren that "mankind" was probably a sexist term; just how old was this document?

"The discoverer should seek to verify that the most plausible explanation is the existence of extraterrestrial intelligence rather than some other natural or anthropogenic phenomenon . . ."

Well, there was no doubt about it. No natural phenomenon was likely to generate the squares of one, two, three, and four over and over again, and the source was in the direction of Groombridge 1618, a star 15.9 light-years from Earth; Groombridge 1618 was in Ursa Major, nowhere near the plane of the ecliptic into which almost every Earth-made space probe and vessel had been launched. It *had* to be extraterrestrial.

". . . should inform the Secretary General of the United Nations in accordance with Article XI of the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space . . ."

Darren's eyebrows went up. Somehow he doubted that the switchboard at the UN would put his call through to the secretary-general—was it still Kofi Annan?—if he said he was ringing him up to advise him that contact had been made with aliens. Besides, it was 2:00 A.M. here in Ontario, and UN headquarters were in New York; the same time zone. Surely the secretary-general would be at home asleep right now anyway.

"The discoverer should inform observers throughout the world through the Central Bureau for Astronomical Telegrams of the International Astronomical Union . . ."

Good God, is it still possible to send a

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telegram? Is Western Union even still in business? Surely the submission could be made by e-mail . . .

HotBot quickly yielded the URL for the bureau, which still used the word "telegrams" in its name, but one could indeed fill out an online form on their home page to send a report. Too bad, in a way: Darren had been enjoying composing a telegram in his head, something he'd never done before: "Major news *stop* alien signal received from Groombridge 1618 *stop* . . ."

The brief instructions accompanying the form only talked about reporting comets, novae, supernovae, and outbursts of unusual variable stars (and there were warnings not to bother the bureau with trivial matters, such as the sighting of meteors or the discovery of new asteroids). Nary a word about submitting news of the receipt of an alien signal.

Regardless, Darren composed a brief message and sent it. Then he clicked his browser's *back* button several times to return to the *Declaration of Principles*, and skimmed it some more. Ah, now that was more like it: *"The discoverer should have the privilege of making the first public announcement . . ."*

Very well, then. Very well.

There was nothing to do now but wait and see if the beings living on the third planet were going to reply. Palm-Up-Middle-Fingers-Splayed expected they indeed would, but it would take time: time for the laser flashes to reach their destination, and an equal time for any response the inhabitants of that watery globe might wish to send—plus, of course, whatever time they took deciding whether to answer.

There were many things Palm-Up-Middle-Fingers-Splayed could do to while away the time: read, watch a video, inhale a landscape. And, well, had it been any other time, he probably would have contented himself with one of those. The landscape was particularly appealing: he had a full molecular map of the air in early spring from his world's eastern continent, a heady blending of yellowshoot blossoms, clumpweed pollens, pondskins, skyleaper pheromones, and the tang of ozone from the vernal storms. Nothing relaxed him more.

He'd been afraid at first to access that molecular map, afraid the homesickness would be too much. After all, their ship, the *Ineluctable*, had been traveling for many years now, visiting seven other star systems before coming here. And there were still three more stars—and several years of travel—after this stop before Palm-Up-Middle-Fingers-Splayed would really get to inhale the joyous scents of his homeland again. Fortunately, though, it had turned out that he *could* enjoy the simulation without his tail twitching too much in sadness.

Still, this was not any other time; this was the period when, had they been back home, all three moons would have risen simultaneously, the harmonics of their vastly different orbital radii briefly synchronizing their movements. This was the time when the tides would be at their highest, when the jewelbugs would be taking to the air—and when the females of Palm-Up-Middle-Fingers-Splayed's kind would be in estrus.

Even aboard ship, the estrus cycle continued, never losing track of its schedule. Yes, despite his race's hopes, even shielding females from the light and gravitational effects of the moons did nothing to end the recurring march. The cycle was so ingrained in <hand-sign-naming-his-species> physiology that it maintained its precision even in the absence of the stimuli that must surely have originally set its cadence.

Palm-Up-Middle-Fingers-Splayed took one last look out his window at the distant yellow star. The planet they'd signaled was invisible without a telescope, although two of the gas giants—the fifth and sixth worlds—shone brightly enough to be seen with naked eyes, despite presenting only crescent faces

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from this distance.

The ship's computer would flash a signal to alert Palm-Up-Middle-Fingers-Splayed, of course, if any response were received. He set out to find his mate, to find his dear Fist-Held-Sideways.

Fist-Held-Sideways was in the forward mess hall when Palm-Up-Middle-Fingers-Splayed caught up with her. Now that the *Ineluctable*'s great fusion motors were quiescent, the false sense of gravity had disappeared. Fist-Held-Sideways was floating freely, her gray tail with its blue mottling sticking up above her in a most appealing way.

Palm-Up-Middle-Fingers-Splayed hovered in the doorway, not moving, just watching her as she ate. Her chest opened vertically, revealing the inside of her torso, the polished pointed tips of her ribs moving apart as she split herself wider and wider. Fist-Held-Sideways used the arm coming out of the left side of her head to swat a large melon that had been floating by, directing it into her belly. Palm-Up-Middle-Fingers-Splayed watched as the tips of her ribs came together, crushing the melon, a few spherical drops of juice floating out of Fist-Held-Sideways's torso before she closed the feeding slit. A small mechanical cleaner, moving about the room with the aid of a propeller, sucked the juice out of the air and then demurely retreated.

It wasn't easy getting another <hand-sign-naming-his-species>'s attention in zero gravity. On a planet's surface, one might slap one's tail against the floor hard enough so that the other would feel the vibrations through his or her own tail and feet. But when floating freely, that didn't work; indeed, slapping a tail like that would send you shooting up toward the ceiling, banging your head.

Palm-Up-Middle-Fingers-Splayed used the hand coming out of the right side of his head to push against the doorframe, propelling himself into the mess hall. As soon as he came within Fist-Held-Sideways's field of view, she flared her nasal slits in greeting, welcoming his scent, then used both her hands to make signs. "Palm-Up-Middle-Fingers-Splayed!" she exclaimed, hyperextending her fingers after finishing his namesign to convey her pleasant surprise. "Good to see you! No reply from the aliens yet?"

Palm-Up-Middle-Fingers-Splayed balled his left hand in negation. "It's still much too early. So far, I've just sent them one, four, nine, and sixteen over and over again; sort of a general hello, one sentient race to another. It'll be some time before we receive any response." He paused, seeing if his mate would pick up the hint.

And, of course, she did; Palm-Up-Middle-Fingers-Splayed had heard from Palm-Down-Thumb-Extended, who had been Fist-Held-Sideways's mate last breeding season, that she was wonderfully intuitive and empathetic—unusual, but very desirable, traits in a female: "Your quarters or mine?" signed Fist-Held-Sideways.

"Yours," Palm-Up-Middle-Fingers-Splayed signed back, flexing his wrist wryly. "Too many breakables in mine."

The sex, as always, was athletic. Palm-Up-Middle-Fingers-Splayed enjoyed the exercise, enjoyed the tumbling in zero-g, enjoyed the physical contact with Fist-Held-Sideways. But it was the actual consummation, of course, that he was waiting for. Palm-Up-Middle-Fingers-Splayed was a biologist and, although he had indeed repeatedly taught students the precise biochemistry involved, it still fascinated the intellectual part of him every time it happened: when a male's semen finally reached the female's hexagon of egg-cells, a chemical reaction occurred producing a neurotransmitter that brought intense pleasure to both the female and the male, just as—

Yes, yes! Contact! The sensation washed over him, his tail going rigid in excitement, his twin hearts pounding

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out of synch, his rib points clamping together, as he was overcome by the joy, the joy, *the joy* . . .

Palm-Up-Middle-Fingers-Splayed was a considerate enough lover to take additional pleasure from the writhing of Fist-Held-Sideways's body. He squeezed her tighter, and they both relished the simultaneous climax of their intercourse. As they relaxed, floating in the room, the warm afterglow of the neurotransmitter washing over them, Palm-Up-Middle-Fingers-Splayed thought that the Five Gods had indeed been wise. Only together could males and females experience such joy, and—oh, the gods had indeed been brilliant!—it happened *simultaneously*, compounds from his body mixing with chemicals from hers, producing the neurotransmitter. The simultaneity, the shared experience, was wonderful.

Of course, as usual, it would be a problem figuring out what to do with the new children. His race had been saddened indeed when it discovered that any process or barrier that prevented conception also prevented orgasm, and that, because of the neurological interdependence of the fetuses and their host, to terminate a pregnancy would kill the mother.

No, the only method to keep new children from being born was to avoid copulation altogether. And, well, when a female was in estrus, her pheromones—those wonderful, wonderful pheromones—were completely irresistible.

The <hand-sign-naming-his-species> had no choice. With an ever-expanding population, they had to find new worlds to colonize.

Darren's next-door neighbor's brother-in-law worked for Newsworld, the CBC's all-news cable channel. He'd met the guy a couple of times at parties at Bernie's place. Darren couldn't recall exactly what the guy did. Director? Switcher? Some behind-the-scenes function, anyway; they'd had a fairly empty conversation last time, with Darren asking him if Wendy Mesley was as cute in real life as she looked on TV. Of course, at this time of night, he didn't want to call Bernie and wake him up—"next door" was a bit of a misnomer; Bernie's place was the better part of a kilometer up the country road.

But at that last party Bernie had held—back in June, it must have been—Bernie's brother-in-law had had to leave early, to get down to Toronto and go to work. So he pulled the night shift at least some of the time, meaning there was a chance he might be at the CBC right now. But what the heck was the guy's name? Carson? Carstone? Carstairs? Something like that . . .

Well, nothing to be lost by trying. He got the CBC number from Toronto directory assistance, dialed it, and was greeted by a bilingual computerized receptionist, which gave him the option of spelling out the last name of the person he wanted to speak to on his touch-tone phone. Fortunately, the system recognized the name by the time Darren had pressed the key corresponding to the fourth letter—the last name, as the system informed him, was in fact Carstairs, and the first name was Rory. Darren was transferred to the correct extension and, miracle of miracles, the actual, living Rory Carstairs answered the phone.

"Overnight," said the voice. "Carstairs."

"Hi, Rory. This is Darren Hamasaki—remember me? I live down the street from your brother-in-law Bernie. We met at a couple of his parties." The words of the automated attendant echoed in Darren's mind: *Continue until recognized.* "I've got one of those beards that a lot of people call a goatee, but it's really a Vandyke, and—"

"Oh, sure," said Carstairs. "The space buff, right? You were pointing out constellations to us in Bernie's backyard. Say, nothing's happened to Bernie, has it?"

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"No, he's fine—at least, as far as I know. But—but I've got some news to report, and, well, I didn't know who else to call."

"I'm listening," said Carstairs.

The carefully devised *Declaration of Principles Concerning Activities Following the Detection of Extraterrestrial Intelligence*, issued by the International Academy of Astronautics in 1989, had been based on the assumption that governments would control access to the alien signals, that giant, multi-million-dollar radio telescopes would be required to pick up the messages.

But the signal Darren had detected was *optical*. Anyone with a decent backyard telescope had been able to pick it out, once he'd made known the celestial coordinates. And in all the places on Earth from which Groombridge 1618 could be seen at night, people were doing just that. Sales of telescopes were at an all-time high, exceeding even the boom during Halley's last visit.

Darren Hamasaki became a media celebrity, interviewed by TV programs from around the world. Of course, all the usual SETI pundits—Seth Shostak and Paul Shuch in the U.S., Robert Garrison in Canada, and Jun Jugaku in Japan—were also constantly being asked for comment. But when the mayor of Las Vegas decided to do something about the alien signal, it was indeed Darren that he called.

Darren had taken to letting his answering machine screen his calls; the phone rang incessantly now. He was leaning back in a leather chair, fingers interlaced behind his head, listening absently to the words coming from the machine's tinny speaker: "Shoot, I'd hoped to catch you in. Mr. Hamasaki, my name is Rodney Rivers, and I'm the mayor of Las Vegas, Nevada. I've got an idea that—"

Intrigued, Darren picked up the phone's handset. "Hello?"

"Mr. Hamasaki, is that you?"

"Speaking."

"Well, looks like I hit the jackpot. Mr. Hamasaki, I'm the mayor of Las Vegas, and I'd like to have you come down here and join us for a little project we got in mind."

"What's that?"

"You ever been to Vegas, son?"

"No."

"Seen pictures?"

"Of course."

"We're one brightly lit city at night, Mr. Hamasaki. So bright, the shuttle astronauts say they can easily see us from orbit. And, well, this is our off-season, you know—the time between Thanksgiving and Christmas. Don't get enough tourist traffic, and it's the tourists that drive our economy, sure enough. So me and some of the boys here, we had an idea."

"Yes?"

"We're goin' to flash the lights of Las Vegas—every dang light in the blessed city—on and off in unison. Send a reply to them there aliens you found."

Darren was momentarily stunned. "Really? Is that—I mean, can you do that? Are you allowed to?"

"This is the U.S. of A, son—freedom of speech and all that. Of course we're allowed to."

"What are you going to say?"

"That's why I'm callin' you, Mr. Hamasaki. We want you to help us work out what the reply should be. Any chance I could entice you down here with a free trip to Vegas? We'll put you up at—"

"At the Hilton. Isn't that the one with *Star Trek: The Experience?*"

The mayor laughed. "If that's what you'd like. How soon could you get down here?"

Mayor Rivers was certainly savvy. Over one hundred thousand extra tourists came to Las Vegas to be part of the great signaling event; it was the best early-December business the city had ever had.

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Darren Hamasaki's first inclination had been to send a simple message in response. The aliens—whoever they might be—had signaled one flash, four flashes, nine flashes, and sixteen flashes, over and over again; those were the squares of one, two, three, and four. Darren thought the logical reply might be the cubes of the first four integers: one, eight, twenty-seven, and sixty-four. Not only would it make clear that the people of Earth understood the original message—which simply parroting it back wouldn't necessarily have conveyed—but it would also indicate that they were ready for something more complex.

But Las Vegas was a city of spectacles; being that prosaic wouldn't do. Darren spent a week devising a more content-rich message, using the form Frank Drake had worked out for Earth's first attempt at communicating with aliens, back in 1974: an image made of a string of on/off bits, the length of the string being the product of two prime numbers—in this case fifty-nine and twenty-nine.

Arranging the bits as a grid of fifty-nine rows each twenty-nine columns wide produced a crude picture. Darren coded in a simple diagram of a human being, and, because ever since he'd read Lilly in college, he'd believed dolphins were intelligent, a simple diagram of a bottle-nosed dolphin, too. He then put binary numbers underneath, expressing the total populations of the two species, and a crude diagram of the western hemisphere of the Earth, showing that the humans lived on the land and the dolphins in the ocean.

Media from all over the world came to cover the event. Mayor Rivers and Darren were invited to the master control room of the Clark County Power Authority. The entire power grid could be controlled from a single computer there. And, at precisely 10:00 P.M., the mayor pushed the key to start the program running. It began—and would end—with one solid minute of darkness, then a solid minute of light, and then another of darkness, to frame the message. Then the glowing marquee at Caesars Palace winked at the night sky, the floodlights at Luxor strobed against the blackness, the neon tubes at the MGM Grand flickered off and on. All along the Las Vegas strip, and in all the surrounding streets, the lights blinked out the 1,711 bits of Darren's reply.

Out front of Bally's, surrounded by a huge crowd, a giant grid of lights—specially powered by gas generators—filled in with the pixels of the message, one after the other, line by line, from upper left to lower right, painting it as it was transmitted. The crowd cheered when the human figure was finished, thousands of people raising their right arms in the same salute of greeting portrayed in the message.

After the message had been completed, the mayor took to the podium and addressed the assembled mass, thanking them for their orderly conduct. Then His Honor invited Darren to say a few words.

Darren felt the need to put it all in perspective. "Of course, Groombridge 1618 is almost sixteen light-years from Earth," he said into the mike, his voice reverberating off the canyon of hotels surrounding him. "That means it will take sixteen years for our signal to reach the aliens there, and another sixteen before any reply they might send could be received." This being Las Vegas, there were already betting pools about what date the aliens might reply on, and what the content of their next message might be.

Darren refrained from remarking about how exceedingly unlikely it would be that the aliens would be able to detect one blinking city against the glare of Earth's sun behind it; if humanity ever really wanted to seriously respond, it would likely need to build a massive laser to do so.

"Still," said Darren, summing up,

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"we've had a lot of fun tonight, and we've certainly made history: humanity's first response to an alien signal. Let's hope that if a reply does come, thirty-odd years from now, we'll have made new friends."

The head of the power authority had the final words for the evening; the crowd was already dispersing by this point—heading back to the casinos, or the hotels, or the late Lance Burton show during which his assistants were topless, or any of the hundreds of other diversions Las Vegas offered at night.

Darren felt a twinge of sadness. He'd enjoyed his fifteen minutes of fame—but now, of course, the story would slip from public consciousness, and he'd go back to his quiet life in rural Ontario.

Or so he'd thought.

Palm-Up-Middle-Fingers-Splayed had spent the entire night in Fist-Held-Sideways's quarters, but had left by the time ship's morning had rolled around. He was one of ten males aboard the *Ineluctable*, and she, one of ten females. As on the homeworld, though, females were loners, while males—who in ancient times had watched over the clutches of six eggs laid and then abandoned by each female—lived communally. The *Ineluctable*'s habitat was shaped like a giant wheel, with ten spokes, each one leading to a different female's lair; the males lived together in the hub.

It was shortly after the fifth daypart when the computer turned on a bright light to get Palm-Up-Middle-Fingers-Splayed's attention. The digitized blue hands on the monitor screen signed the words with precise, unemotional movements. "A response has been received from the third planet."

Palm-Up-Middle-Fingers-Splayed gave himself a three-point launch down the corridor, pushing off the bulkhead with both feet and his broad, flat tail. He barreled into the communications room. Waiting there were three other males, plus one female, Captain Curling-Sixth-Finger herself, who had come into the hub from her command module at the end of spoke one.

"I see we've made contact," signed Palm-Up-Middle-Fingers-Splayed. "Has the reply been deciphered yet?"

"It seems pretty straightforward," said Palm-Down-Thumb-Extended. "It's a standard message grid, just like the ones we were planning to use for our later messages." He made a couple of signs at the camera eye on the computer console, and a screen came to life, showing the message.

"The one on the left is the terrestrial form," continued Palm-Down-Thumb-Extended. "The one on the right, the aquatic form. It was the terrestrial form that sent the message. See those strings beneath the character figures? We think those might be population tallies—meaning there are far, far more of the terrestrial form than of the aquatic one."

"Interesting that a technological race is still subject to heavy predation or infant mortality," signed Palm-Up-Middle-Fingers-Splayed. "But it looks as though only a tiny fraction survive to metamorphose into the adult aquatic form."

"That's my reading of it, too," said Palm-Down-Thumb-Extended. His hands moved delicately, wistfully. There had been a time, of course, when the <hand-sign-naming-his-species> had faced the same sort of thing, when six offspring were needed in every clutch, and countless clutches were needed in a female's lifetime, just in hopes of getting two children to live to adulthood. So many had fallen prey to gnawbeasts and sky-swoopers and bloodvines—

But now—

But now.

Now almost all offspring survived to maturity. There was no choice but to find new worlds on which to live. It was a difficult task: no world was suitable for habitation unless it already had an established biosphere; only the action of life could produce the carbon dioxide and oxygen needed to make a breathable

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atmosphere. And so the *Ineluctable* traveled from star to star, looking for worlds that were fecund but not yet overcrowded with their own native life forms.

"Maybe they do it on purpose," signed Captain Curling-Sixth-Finger. Palm-Up-Middle-Fingers-Splayed was grateful for the zero gravity; if they'd been on a planet's surface, Curling-Sixth-Finger would have towered over him, just as most adult females towered over most males. But here, with them both floating freely, the difference in size was much less intimidating.

"Do what?" signed Palm-Up-Middle-Fingers-Splayed.

"Maybe they cultivate their own predators," replied Curling-Sixth-Finger, "specifically to keep their population in check. There are—what?" She peered at the binary numbers beneath the blocky drawings. "Six billion of the terrestrial forms? But only a few million of the aquatic adults."

"So it would seem," said Palm-Up-Middle-Fingers-Splayed. "It's interesting that their adult form returns to the water; on the world of that last star we visited, the larvae were aquatic and the adults were land-dwellers." He paused, then pointed at the right-hand figure's horizontally flattened tail. "They resemble the ancestral aquatic forms of our own kind from millions of years ago—even down to the horizontal tail fin."

Curling-Sixth-Finger spread her fingers in agreement. "Interesting. But, enough chat; there are important questions we have to ask these aliens."

Darren Hamasaki had just checked in at the Air Canada booth at the Las Vegas airport and was on his way to the Star Alliance lounge—his trip last year to see the eclipse in Europe had got him enough points to earn entry privileges—when Karyn Jones, one of Mayor Rivers's assistants, caught up with him.

"Darren!" she wheezed, touching his arm, and buying herself a few seconds to catch her breath.

"What is it?" said Darren, raising his eyebrows. "Did I forget something?"

"No, no, no," said Karyn, still breathing raggedly. "There's been a *reply*."

"Already?" asked Darren. "But that's not possible. Groombridge 1618 is 4.9 parsecs away."

Karyn looked at him as though he were speaking a foreign language. After a moment, she simply repeated, "There's been a reply."

Darren glanced down at his boarding pass. Karyn must have detected his concern. "Don't worry," she said. "We'll get you another flight." She touched his forearm again. "Come on!"

Of course, many observatories now routinely watched Groombridge 1618; it was under twenty-four-hour surveillance from ground stations, and was frequently examined by Hubble, as well—not that a reply was expected soon, but there was always the possibility that the aliens would send another message of their own volition, prior to receiving a response from Earth. Even so, few in the astronomical community seriously believed the Groombridgeans would ever see the Las Vegas light show, and the United Nations was still debating whether to build a big laser to send an official reply.

And so, Darren saw the alien's response the same way most of the world did: on CNN.

And a *response* it surely was, for in layout and design it precisely matched the message Mayor Rivers had arranged to be sent. The aliens were bipedal, with broad, flat tails like those of beavers; *Tailiens* was a word the CNN commentator was already using to describe them. Their heads sported V-shaped mouths, and arms projected from either side of the head. There was something strange about their abdomens, though: a single column of zero bits—blank pixels—ran down the length of the chest; what it signified,

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Darren had no idea.

CNN took away the graphic of the message and replaced it with the anchor's face. "Do you have it on videotape?" asked Darren. "I want to examine the message in detail."

"No," said Karyn. "But it's on the CNN web site." She pointed to an iMac sitting across the room; sure enough, the graphic was displayed on its screen. Darren bounded over to it. He was still trying to take it all in, trying to discern whatever details he could. In the background, he could hear the CNN anchor talking to a female biologist: "As you can see," the scientist said, "the aliens presumably evolved from an aquatic ancestor, not unlike our own fishy forebears. Our limbs are positioned where they are because those were the locations of the pectoral and pelvic fins of the lobe-finned fish we evolved from. This creature's ancestors presumably had its front pair of fins further forward, which is why the arms ended up growing out of the base of the head, instead of the shoulders, and . . ."

Darren tried to shut out the chatter. His attention was caught by the string of pixels beneath the alien figure.

The very long string of pixels . . .

The crew of the *Ineluctable* hadn't bothered to send an image of a juvenile of their kind alongside the adult; unlike the strange beings they were now communicating with, they had no larval form—babies looked just like miniature adults.

Palm-Up-Middle-Fingers-Splayed and the others didn't wait for another reply from the denizens of the third planet before flashing a series of additional pictures at them. These were standard images, already prepared, showing details of <hand-sign-naming-his-species> physiology at a much higher resolution than that used for the earlier message. The aliens, after all, had seemed willing to reveal their own body form—or forms, given the two lifestages depicted in their first missive. Perhaps they would respond with more details about their own kind.

And then they could determine whether these people and the members of <hand-sign-naming-his-species> would be able to share a world together.

"They're not at Groombridge 1618," Darren said to Mayor Rivers, when His Honor arrived shortly after midnight; the mayor's toupee had been hastily perched and now sat somewhat askew atop his head. "They can't be. Assuming they responded immediately upon receipt of our message, they're only a few light-*hours* away—about the distance Pluto is from the Earth, although, of course, they're well above the plane of the solar system." Darren frowned. "They *must* be in a spaceship, but . . . but, no, no, that can't be right. Every observatory on Earth has been taking the spectra of the laser flashes, and they're dead on the D_1 sodium line, which can't be a coincidence. The senders are using a line that's weak in their home star but very strong in our own Sun's spectrum to signal us. But, like I said, it's *dead on* that line, meaning there's no Doppler shift. But if the ship was coming towards us, the light from the laser would be blue-shifted, and—"

"And if it were a-flyin' away from us," said Mayor Rivers, "it would be red-shifted."

Darren looked at His Honor, surprised. Rivers lifted his shoulders a bit. "Hey, we're not all hicks down here, you know."

Darren smiled. "But if the light isn't undergoing a Doppler shift, then—"

"Then," said Rivers, "the starship must be holdin' station, somewhere out there near the edge of the solar system."

Darren nodded. "I wonder why they don't come closer?"

The next night, Darren found himself flipping channels in his hotel room—they'd put him back in the Hilton. Let-

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terman did a top-ten list of people who would make the best ambassadors to visit the aliens ("Number four: Robert Downey, Jr., because he's been damn near that high already"). And Leno did a "Jay Walking" segment, asking people on the street basic questions about space; Darren was appalled that one person said the Sun revolved around the Earth, and that another declared that Mars was "millions of light-years" away.

After that, though, he switched to *Nightline*, which had some more serious discussion of the aliens. Ted Koppel was interviewing a guy named Quentin Fawcett, who was billed as an "astrobiologist."

"I've been studying the anatomical charts that the Tailiens sent us," said Fawcett, whose long hair was tied into a ponytail. "I think I've figured out why they don't use radio."

Koppel played the stooge well. "You figured that out from anatomical charts? What's anatomy got to do with it?"

"Can we have the first slide?" asked Fawcett. A graphic appeared on the monitor between Koppel and Fawcett, and, a second later, the image on Hamasaki's hotel-room TV filled with the same image, as the director cut to it. "Look at this," said Fawcett's voice.

"That's the one they're calling three-dash-eleven, isn't it?" said Koppel. "The eleventh picture from the third group of signals the Tailiens sent."

"That's right. Now, what do you see?"

The TV image changed back to a two-shot of Koppel and Fawcett, both looking at their own monitor. "It's the Tailien head," said Koppel. And indeed it was, drawn out like an alligator's.

"Look carefully at the mouth," said Fawcett.

Koppel shook his head. "I'm sorry; I'm not getting it."

"That's not a picture of the head, you know. It's a picture of the Tailien cranium—the skull."

"Yes?"

"It's all one bone," said Fawcett triumphantly. "There's no separate mandible, no movable jaw. The mouth is just a boomerang-shaped opening in a solid head."

Koppel frowned. "So you're saying they couldn't articulate? I guess it *would* be hard to talk without a hinged jaw." He nodded. "No talking, no radio."

"No, it's not the ability to make sounds that depends on the advent of jaws. It's the ability to *hear* sounds, or, at least, to hear them clearly and distinctly."

Koppel waited for Fawcett to go on. "I've got TMJ—temporomandibular-joint syndrome," said Fawcett, tapping his temple. "Discomfort where the jaw articulates with the temporal bone; it's pretty common. Well, last winter, I had an infection in my ear canal—'swimmer's ear,' they called it. Except I didn't know it for the longest time; I thought the pain was from my TMJ. Why? Because our ears are located right over our jaw joints—and that's no coincidence. The small bones in our inner ear—the hammer, the anvil, and the stirrup—make our acute hearing possible, and they exist precisely because the skull splits there into the cranium and the jaw. Our earliest vertebrate ancestors were jawless fish—fish with heads very much like the Tailiens still seem to have, consisting of one solid piece of bone."

Koppel was coming up to speed. "So . . . so, what? They take in soft food through permanently open mouths? No chewing?"

"Perhaps," said Fawcett. "Or maybe that slit that runs down their torsos is a feeding orifice. But, either way, I'm willing to bet that they don't depend on sound for communication."

Darren worked with an illustrator from the Las Vegas *Review-Journal* and a doctor from the UNLV Medical Center coding a series of human-anatomy diagrams, but no one quite knew how to send them. It would take more than a day of flashing the city's lights on and

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off—the power could only be cycled so quickly—to send even one of these high-resolution images, and the casinos wouldn't stand for it. Every minute the power was off cost them tens of thousands of dollars in betting revenues.

But, before they'd figured out how to reply, a new set of messages—batch number four—arrived from the Tailiens.

Palm-Up-Middle-Fingers-Splayed personally supervised the sending of the next messages, since he'd been the one who had coded them. They were designed to convey a series of simple multiple-choice questions. The messages consisted of twenty-three rows of seventy-nine columns, much smaller than the anatomical charts. Fist-Held-Sideways had opined that bandwidth might be a problem for the third planet in sending similar messages, which is presumably why no response had yet been received.

The top part of each message showed a simple math problem, and the bottom part showed three possible answers, one of which was correct. The boxes containing these answers were labeled, from left to right, with one pixel, two pixels, and three pixels respectively in their upper right-hand corners.

Palm-Up-Middle-Fingers-Splayed, Fist-Held-Sideways, and the rest awaited the answers from the third planet; nothing less than a perfect score on the test would be morally acceptable before they asked the most important question of all.

The aliens seemed to have no trouble reading the flashing of Las Vegas's lights, and so the responses to the math problems were sent by that city winking itself on and off. Many of the hundred thousand people who had come to Nevada to be part of the first signaling effort were still in town, thrilled that an actual dialogue between humans and aliens seemed to be opening up.

Fortunately for the croupiers and pit bosses, the math problems only took seconds to reply to; all that had to be sent was the number of the box containing the correct answer: one flash, two flashes, or three flashes.

"There's no doubt," signed Palm-Up-Middle-Fingers-Splayed to Captain Curling-Sixth-Finger, "that the aliens understand our syntax. They clearly know how to give the correct response to a multiple-choice question—and they got all the answers right, even the one about division by zero."

"Very well," said Curling-Sixth-Finger, her fingers moving slowly, deliberately. She clearly was steeling herself, in case she had to repeat the action she'd been forced to take at the last star system. "Ask them the big one."

The next message was, in the words of Larry King, who had Darren Hamasaki on his show to talk about it, "a real poser."

"It looks," said King, leaning forward on his desk, his red suspenders straining as he did so, "like they're asking us something about DNA, isn't that right, Mr. Hamasaki?"

"That does seem to be the case," said Darren.

"Now, I don't know much about genetics," said King, and he looked briefly into the camera, as if to make clear that he was speaking on behalf of his viewing audience in confessing this ignorance, "but in *USA Today* this morning, there was an article saying that it didn't make sense that the aliens were talking to us about DNA. I mean, DNA is what life on Earth is based on, but it isn't necessarily what alien life will be based on, no? Aren't there other ways to make life?"

"Oh, there might very well indeed be," said Darren, "although, you know, try as we might; no one has come up with a good computer model for any other form of self-replicating biochemistry. But I don't think it matters. Life didn't begin on Earth, after all. It was im-

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ported here, and—"

"It *was?*" King's eyebrows shot up toward his widow's peak. "Who says so?"

"Lots of biologists—more and more each day. You know, the initial problem with Darwin's theory of evolution was this: it was clear that the process of natural selection would take a long time to develop complex life forms—but there was no evidence that the Earth was particularly old; we didn't have any proof that it was old until the discovery of radioactivity. Then, when we found that Earth was *billions* of years old, it seemed that there was plenty of time for evolution. But now we've run into another not-enough-time problem: the oldest known fossils are four billion years old, and they're reasonably complex, which means if life were indigenous to Earth, the first self-replicating molecules would have had to appeared only a few hundred million years after the solar system was born, four-and-a-half billion years ago."

"We're going to get letters, I know it," said King, "from people disputing those age claims. But go on."

"Well, that early on, Earth was still being bombarded by meteors and comets; extinction-level events would have been common. Earth simply wouldn't have presented a stable environment for life."

"So you think life came here from outer space?"

"Almost certainly. Some biologists believe that it arose first on Mars—Mars was much drier than Earth, even back then. A comet or asteroid impact has a much greater destabilizing effect on the climate if it hits water than it does if it hits dry land. But the original DNA on Earth could have also come from outside the solar system—meaning, in fact, that these Tailiens might be our distant, distant relatives. All life in this part of the galaxy might share a common ancestor, if you go back far enough."

"Fascinating," said King. "Now, what about this latest message from the Tailiens? Can you take us through that?"

"Well, the top picture shows what looks to be a snippet of DNA, three codons long."

"Codons?"

"Sorry. Words in the DNA language. We read the language a letter at a time: A, C, G, or T. And since A and T always bond together, and G always bonds with C, we can just read the letters off one half of the DNA ladder and know automatically what the letters down the other side will be."

King nodded.

"Well," continued Darren, "each group of three letters—ACG, say, or TAT—is a word, specifying one amino acid, and amino acids are the building blocks of life. What we have in the first picture is a snippet of DNA consisting of nine letters, or three words. Next to that, there's space for another snippet of DNA the same length, see? As if you were supposed to place one of the strings from the lower section up here beside this one."

"And how do we choose which one should go there?"

Darren frowned. "That's a very good question, Larry." It was cool getting to call him Larry. He looked at his cheat-sheet on the desktop. "The sequence in the top part of the message is CAC, TCA, and GTC, which codes, at least here on Earth, for the amino acids histidine, serine, and valine."

"Okay," said King.

"And the three possible replies are below. Two of them are strings of DNA. The first one—in answer box one—is a string of DNA very similar to the one above. It reads as CAC—the same as before; TTA—which is one nucleotide different from the string on the top, so it codes for, umm, let me see, for leucine instead of serine; and then there's GTC again, which is valine, just as before."

"So it differs by only one-ninth from the specimen at the top," said Larry. "A close relative, you might say."

Darren nodded. "Exactly. And that brings us to the second possible re-

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sponse. Like the first possible response, it consists of nine codons, but here the codons don't match at all—the sequence is completely different from the one above. And, if you look carefully, you'll see it's not just frameshifted out of synch from the sample above; it really has nothing in common with it. Nor could it be a possible match for the other side of the DNA ladder, because it doesn't have the same pattern of duplicated letters."

"So that second string of DNA represents a distant relative—if it's a relative at all," said King. "Would that be right?"

"It's as good a guess as any," said Darren.

"And the third possible answer?" asked King.

"That's the puzzler," said Darren. "The third answer box is empty; blank. There's nothing in it except three pixels in the upper right, which just indicate that it *is* the third possible answer."

"Have we ever seen an empty box like that before in one of the Tailiens' messages?" asked King.

"Yes," said Darren. "It was in message four-dash-twelve, one of the math problems. They asked us what the correct answer to six divided by zero is. The possible answers they gave us were six, one, and a blank box."

"And—wait a second, wait a second—you can't divide by zero, can you?"

"That's right; it's a meaningless concept: how many times does nothing go into something? So, in that case, we chose the empty box as our answer."

"And what's the correct answer this time?" asked King.

Darren spread his arms, just as he'd seen dozens of other people—including many working scientists, rather than hobbyists like him—do today on other talk shows when asked the same question. "I haven't the slightest idea."

Everybody had hoped that other messages would continue to come from the Tailiens. Just as they had gone on to send the math problems after receiving no reply to the anatomy diagrams, humanity hoped that they would continue sending questions or information before a reply was sent.

But the Tailiens didn't. They seemed to be intent on waiting for a response to the DNA puzzle.

And, finally, the United Nations decided that one should indeed be sent. By this point, Darren was pretty much out of the spotlight—and glad of it. The United Nations secretary-general himself was coming to Las Vegas to initiate the blinking of the city's lights. That was fine with Darren; he wasn't sure that the UN scientists had come up with the right answer, and he didn't want sending an incorrect reply to be on his head.

The answer the UN had decided to go with was number one: the DNA that was similar, but not identical, to the sample string. There were various rationales offered for supposing that it was the correct response. Some said it was obvious: the aliens were moving us beyond questions of absolute truth, the kind of clear right or wrong that went with mathematical expressions; this new message was designed to test our ability to think in terms of similarity, of soft relationships. Although none of the three choices matched the sample string, the first one was the most similar.

Another interpretation was that it was a test of our knowledge of evolution. Did new species (the blank space to the right of the sample string) emerge by gradual changes (answer one, with its single nucleotide difference); by complete genetic redesign (answer two, with its totally dissimilar DNA); or out of nothing—that is, through creationist processes?

Some of the fundamentalists at the UN argued that the third answer was therefore the proper one: the aliens were testing our righteousness before deciding whether to admit us to the galactic club. But others argued that

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everything the aliens had presented so far was scientific—mathematics, anatomical charts, DNA—and that the scientific answer was the only one to give: new species arose by incremental changes from old ones.

Regardless of whether it was a question about inexact relationships or about the principles of evolution, answer one would be the correct response. And so the lights of Las Vegas were turned off one last time in a single, knowing wink at the heavens.

Palm-Up-Middle-Fingers-Splayed happened to be in the communications room when the response was received from the third planet. Of course, regardless of what answer they'd chosen, it would begin with one stretch of darkness, so Palm-Up-Middle-Fingers-Splayed waited . . . and waited . . . and waited for a second and third.

But more darkness never came. Palm-Up-Middle-Fingers-Splayed's tail twitched.

He had to tell Captain Curling-Sixth-Finger, of course; indeed, the computer had probably already informed her that a response was being received, and she was presumably even now making her way down the spoke from her command module, and—

And there she was now: twice Palm-Up-Middle-Fingers-Splayed's size, and capable of the kind of fierceness only a female could muster.

"What is the response?" demanded Curling-Sixth-Finger as she floated into the room.

"One," signed Palm-Up-Middle-Fingers-Splayed with restrained, sad movements. "They chose answer one."

Curling-Sixth-Finger's feeding slit momentarily opened, exposing slick pink tissue within. "So be it," she signed with her left hand, and "So be it," she repeated with her right.

Palm-Up-Middle-Fingers-Splayed whipped his tail back and forth in frustration. It was such a straightforward question: when seeking other life forms to associate with, do you choose (1) the being most closely related to you genetically; (2) the being least related to you genetically; or (3) is it impossible to answer this question based on genetics?

Answer three, of course, was the morally right answer; any advanced being must know that. Oh, it was true that primitive animals sought to protect and favor those with whom they shared many genes, but the very definition of civilization was recognizing that nepotism was not the engine that should drive relationships.

Perhaps, reflected Palm-Up-Middle-Fingers-Splayed, such enlightenment had come more easily to his people, for with partners changing every mating season, genetic relationships were complex and diffuse. The race inhabiting the second planet of the star they had last visited had chosen the wrong answer, too; they'd also picked the first choice.

And they'd paid the price for that.

If nepotism drives you as a species, if protecting those who are most closely related to you is paramount, if forming allegiances based on familial lines is at the core of your society, then how can you ever be trusted in relationships with beings that are alien to you? Yes, it seemed all life, at least in this neighborhood of the galaxy, was based on DNA, and therefore was quite possibly related in its distant, distant past. But, then again, all creatures on any given world also share a common ancestor. And yet—

And yet these benighted souls of the third planet still chose genetic favoritism; indeed, they were so convinced of its righteousness, convinced that it was the proper order of things, that they didn't even attempt to disguise it by giving a false answer. Those poor creatures, prisoners of their own biology . . .

Curling-Sixth-Finger was already on the intercom, calling down to the propulsion room, telling Fist-Held-Sideways to engage the fusion motors. Palm-

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Up-Middle-Fingers-Splayed felt an invisible hand pressing down upon him, driving him to the floor, as the great engines came to life. As he and Curling-Sixth-Finger settled to the deck plates, Palm-Up-Middle-Fingers-Splayed looked up at her.

"I've got no choice," she signed. "A species driven by selfish genes is too dangerous to be allowed to live."

Palm-Up-Middle-Fingers-Splayed slowly, sadly spread his fingers in agreement. The *Ineluctable* would dive down into the plane of the solar system, into the cometary belt just past the orbit of the eighth planet, and it would launch a series of comets on trajectories that would send them sailing in for eventual rendezvous with the third planet.

Oh, it would take time—thousands of years—before the impacts. But eventually they *would* strike, and two skyswoopers would be felled with a single rock: the galaxy would have one less selfish species to worry about, and, with most of its native life wiped out, there would be room—a whole new world!—to move billions and billions of members of <hand-sign-naming-his-species> to.

Palm-Up-Middle-Fingers-Splayed was glad that Fist-Held-Sideways and the other females were no longer in estrus. He didn't feel like making love, didn't feel like making babies.

Not now. Not right now.

But, of course, he *would* want to do that again the next time the females came into heat. He, too, he reflected, was a prisoner of biology—and for one brief moment, that shared reality made him feel a bond with the aliens that now, sadly, he would never meet. ■

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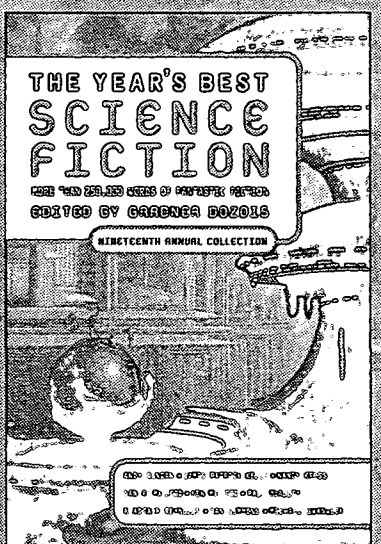

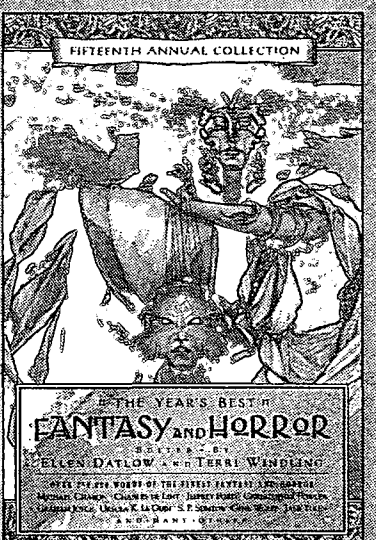

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STEM CELLS AND HUMAN CLONING: THE POSTMODERN PROMETHEUS

Joan Slonczewski

A biologist takes a calm look at an imminent possibility, long dismissed as "just science fiction," at which many people can't look calmly.

In 1818, Mary Shelley wrote *Frankenstein; or the Modern Prometheus*, the stunning depiction of a human taking over God's power of creation of life. Shelley portrayed the inordinate curiosity of young Dr. Frankenstein, his obsession with knowledge for knowledge's sake and for the glory of curing human disease, of achieving biological immortality. Yet in the very instant of success, the human creator rejected outright his creation as "monstrous," unfit for being, undeserving of human life.

Today, with human cloning, we stand on the threshold of an actual Frankenstein-like event: the cloning of the first human being generated in a test tube with electrical stimulation, without "natural" germ cells, the time-honored sperm and egg. But today's world is vastly different from the nineteenth century. In *Prometheus*, a mad scientist creates a monster by engineering a human with fruit fly DNA. The monster gets loose and causes mayhem in a small rural town. This episode is actually a fair dig at molecular biology, whose practitioners can claim with a straight face that the human genome has a gene for fly wings. Today this Franken-science offers yet more fearful monsters, called "embryonic stem cells"—monsters that claim to offer replacement organs, perhaps immortality, for us all. But how did all this monstrous biotechnology get here, exploding as if from nowhere onto the moral and political agenda?

In some ways the history of reproductive science has actually shaped our views of what conception is, more than we realize. Let's review how we reached our current understanding of conception and development of the embryo,

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cells. Finally, I'll attempt to share a biologist's perspective on the moral debate.

History of reproductive technology

The technological transformation of human reproduction came about through molecular biology, a science that is dizzyingly new. Fifty years ago, DNA was unknown, and animal development was studied by pencil drawings of cut-open hen eggs. When DNA was announced by Watson and Crick as the blueprint for life, biologists wondered what became of DNA as developing organs matured. Many believed that the DNA blueprint must degrade as organs "differentiate," their blueprint options narrowed down to one—the liver, say, or the cerebral cortex. The fertilized egg was capable of generating every essential cell type of the body, but the adult body cells, or "somatic cells," appeared to have lost this capacity, restricted to their own final type. Muscle cells, it was thought, didn't need genes to make nerves or kidneys; so they lost them. Only the new body's own "germ cells"—producers of egg or sperm—retained the ability to generate an entire human being.

In the fifties, however, frogs were developed from adult cell nuclei transplanted into enucleated eggs (eggs with the original nucleus removed.) Thus, the adult somatic cells indeed retain all the genes from the original fertilized egg, though all but a few are "switched off," their program unavailable for use. This raised the prospect of creating "human clones," human bodies recreated *in toto* from a single adult cell. Science fiction writers had a field day writing about human clones, even farming them for replacement organs.

In mammals, however, the "off switch" on most adult genes seemed more permanent, and many attempts at cloning failed. We now know that although most mammalian cells retain all their DNA throughout development, their DNA acquires different patterns of "imprinting," extra methyl groups attached to cytosines, one of the four letters in the DNA code. These chemical tags act like punctuation marks, organizing how the DNA blueprint is "expressed," its genes turned on or off. An adult cell nucleus transplanted into an egg would have to correct thousands of these imprinting marks in order to "reset" its genes to restart the program of development without gross errors. For this reason many reproductive biologists considered human cloning impossible.

Thus, in effect, reproductive biologists created and maintained the idea that the egg cell is fundamentally different from all other cells, and that adult cell nuclei could never "go back to the egg." But biochemical reactions by nature are subtle, involving energy shifts that are relatively slight. Most enzymes can catalyze their conversions forward or reverse, depending on available substrates and cofactors. Suppose the methylations of DNA imprinting could be reversed or repatterned. The egg might not look so different after all; at least no more different from adult cells than differentiated cells look from each other—say, a nerve cell compared with a liver cell.

Although cloning of adult nuclei was dismissed, there were other compelling reasons for egg technology, such as help for infertile couples. In 1978, baby Louise Brown was born through "in vitro fertilization" (IVF), the union of sperm and egg in the laboratory, outside the human body. Many religious and ethical spokespeople raised a cry of alarm at this technological transformation of humanity's most intimate practice, the creation of new life. But in medical terms, in vitro fertilization meant an enormous breakthrough for patients suffering one of humanity's oldest sources of heartbreak: the failure to conceive a child. Most scientists saw a huge gulf between "assisted reproduction" and human cloning, which still seemed impossible—and which lacked immediate

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practical application.

In the eighties, cell biology looked more and more like applied chemistry, with molecular machines constructing the body as surely as workers built a skyscraper. The differences between body cell and fertilized egg looked ever smaller—and possibly reversible. Meanwhile, the new biotech industry made transgenic creations: Franken-foods and Franken-animals, such as sheep that produce life-saving human proteins in their milk. These sheep needed their genomes precisely maintained from one generation to the next—in other words, they had to be cloned.

With this need in mind, in 1997 Ian Wilmut achieved the first mammalian clone, the lamb Dolly, from an adult nucleus inserted into an enucleated egg with a jolt of electricity. Dolly was at first largely dismissed as a lucky fluke, or even a fake. It seemed beyond belief that the egg could reset the thousands of imprinting marks—and it sometimes doesn't, leading to frequent aborted embryos. But since then, all kinds of mammals have been cloned, including a monkey and twenty-four "perfect" cows. Can the partridge in the pear tree be far behind?

While the public tried to catch its breath, the technical breakthroughs that made Dolly work enabled dozens of spin-off procedures with even greater potential for medicine. The most exciting is embryonic stem cells, with their potential to replace aging organs. What are all these new technologies? How do they relate to one another, and to the vexing question of human clones?

Reproduction: "natural" and "assisted."

Most of this new technology centers on the unique properties of the human egg. The diagram outlines how human egg cells develop and become fertilized, and how technology can alter the process.

Human eggs develop before birth, from germ-line tissue in the female embryo. During "meiosis I," the first developmental stage, the chromosomes (twenty-three pairs of two) are each duplicated and recombined with their pair-members. Then half the chromosomes are expelled in a polar body, which restores the number of copies to two. At this stage—still containing two copies of each chromosome—the human egg remains in suspended development for many years, until the monthly onset of ovulation.

Human sperm, by contrast, undergo one round of duplication and two rounds of division, leaving just one copy of each chromosome when the sperm matures. At fertilization, as the sperm penetrates the egg, this event signals the egg to undergo its second round of division, expelling half its chromosomes again to leave one copy of each. The fertilized egg now has a full set each from father and mother. It undergoes repeated cell divisions as an embryo.

If all this egg development and embryogenesis sounds baroquely complex, it is. Perhaps that's why only about one in four embryos conceived "naturally" survive until birth. The womb is a harsh place for early embryos; only those that develop perfectly survive. Reproductive scientists now believe that one reason for the high rate of developmental errors in embryos conceived outside the womb is that the petri dish is less hostile to imperfect embryos; doctors try to implant embryos that the womb would reject.

It should be remembered that all egg technology is difficult and involves tedious procedures. Human eggs are tiny, and finding them in the human reproductive tract was an incredible technological feat in itself. Some research has focussed on growing eggs in tissue culture, but with little success so far. So what kind of incentives are there to continue such research?

When human eggs were first isolated, in vitro fertilization to assist infertile couples seemed the one reasonable applica-

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tion. But other applications gradually arose—some obvious, some less so, and some just plain weird. For would-be mothers who could not produce healthy eggs, "egg donors" were sought. Notices appeared on the boards of Ivy League colleges, soliciting eggs. Of course sperm banks were long known, but eggs proved a rarer and therefore more valuable commodity, earning sums that could pay a significant part of one's college bills. (Unfortunately, however, egg donation also jeopardizes the donor's own future fertility.)

The formation of embryos in a dish led to speculation about male pregnancy. In rare cases, embryos have implanted in the abdominal cavity of a woman lacking a uterus, and a normal baby developed to term. In male monkeys, abdominal implantation has been successful. Could human males undertake this? No country now performs this legally, although a mistaken press release from a hospital led to thousands of inquiries.

Meanwhile, as IVF became routine, hundreds of unused embryos accumulated in freezers. Their existence led to questions: Were there uses to which we could put these embryos, other than creating human beings?

The breakthrough—first accomplished in the eighties in mice, and just recently in humans—was the conversion of unused embryos into "embryonic stem cells." Stem cells are a form of tissue culture that retain the capacity of the original embryo to differentiate into any cell type, any tissue, possibly even whole organs. Their imprinting patterns remain close to those of the original fertilized egg.

From a medical standpoint, with long lines of people waiting for livers and kidneys, this prospect was enormously exciting. But a problem remains. No embryo produced by IVF will have the exact genetic composition of potential organ recipients; and therefore, tissue rejection would limit the effectiveness of stem cells for most people.

For women, there may be a solution: embryos by "parthenogenesis," the commencement of embryonic cell divisions from an unfertilized egg. The first step of this process was just reported by a commercial firm last November, although the exact nature of their achievement remains controversial. Parthenogenesis is attractive from a moral standpoint, since the absence of the sperm's contribution of imprinted signals on its DNA means that such "embryos" would lack half the imprinting pattern needed for development and could never become human beings. But the incomplete imprinting might prevent full development of organs as well—and for men, the process will be unavailable.

Suppose instead that we replace the egg's nucleus with the nucleus of a skin cell from the organ recipient. Now the replacement organ would develop with full genetic compatibility to the eventual recipient. Thus, from a practical standpoint, stem cell technology leads inevitably to cloning embryos from adult cells. In effect, the great science fiction dream (or nightmare) is at hand: the cloning of human beings (if an embryo is a human being) to mine them for spare parts.

And what if unexpected applications arise? Suppose someone wants to implant one of those "pre-stem-cell" embryos. If college students can sell their eggs, why can't film stars sell their skin cells to would-be parents?

Moral and political dilemmas

So much for what science is able to do with human eggs, today, and might accomplish tomorrow. But what *ought* we to do; what should be legal in a modern society? Some religions claim to offer clear answers, while others sound less than clear; not surprising, since all the world's major religious traditions arose long before the existence of human eggs was known or imagined. Meanwhile, in modern democracies the

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medical enterprise has become our secular state religion. To save a child's life, anything is permissible—even to generate embryonic siblings and pick the one from the dish whose tissue type matches.

Politically, the debate has split both parties along unpredictable lines. Senator Orrin Hatch concludes that the embryo becomes "human" only once it implants in a uterus; before that, it's fair game for stem cells. Does this mean he now supports anti-pregnancy methods that prevent implantation? Across the aisle, Senator Tom Harkin proposes to ban "reproductive cloning" (nuclear transfer to make a new person) but exempt "therapeutic cloning" (nuclear transfer to make stem cells). This measure, he says, will "open the door to move ahead" with research to turn stem cells into replacement organs. But nuclear transfer is nuclear transfer—surely the practice of it will only hasten the day when humans are cloned.

The biomedical establishment seems to favor Harkin's line. Researchers have so far largely condemned human cloning, while quietly pursuing "nuclear transplantation" to "replace old eggs"—so long as the egg then combines with a sperm. Half a clone is better than none.

Modern democracies generally aim for the Socratic maxim, "Justice is helping friends and harming no one." In other words, we help our fellow citizens and loved ones while trying not to hurt anyone else. So who gets harmed in human cloning? The immediate problems may be medical—some cloned animals develop defects related to the problem of "imprinting." A moratorium on human clones is certainly wise, to make sure we sort this out. If these technical problems get solved, what then?

What about stem cells? There may in fact be a stronger argument that stem cell creation physically harms someone, an embryonic human that never gets to fulfill its potential existence. How real is this harm? Can we simply define life's start at a convenient point, like Senator Hatch, or like researchers who argue that embryonic life begins in week two, with development of the nervous system?

Another view is that all of these technologies and their discussion inevitably cheapen human life and degrade the worth of all human beings. An advisor to President Bush, Professor Leon Kass, makes this argument. While acknowledging the benefits of medical science, "achievements for which we must be grateful," we now find that "human nature itself is on the operating table." Kass argues that even in our rapidly changing society, "we limit so-called reproductive freedom by proscribing incest, polygamy, and the buying and selling of babies." Kass would include on this list of unthinkables abortion and all forms of assisted reproduction, especially human cloning.

Kass and other ethicists point to related quasi-reproductive technologies which, they argue, could replace embryonic stem cells and provide the same hypothetical medical benefits. Recently we have discovered "adult stem cells," undifferentiated cells found in tissues throughout the adult human body. Adult stem cells retain some of the undeveloped character of egg cells, including some of the patterns of imprinting. These cells, we hope, may some day develop replacement organs while avoiding the dilemmas of egg technology. On the other hand, such stem cells with their halfway imprinting might also make ideal candidates for commercial cloning of human adults.

Why is cloning so bad? Kass speaks of the "narcissism of those who would clone themselves," and the "grotesqueness" of those who would clone others. If a person giving birth to her own twin sounds like the ultimate incest, that must be pondered, in a world where even incest and zoophily find proponents on the internet. Ultimately, Kass argues, assisted reproduction turns chil-

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dren into "artifacts" of scientists, instead of the organic products of erotic human beings. Mechanical, unthinking human cloning will ultimately lead to eugenics and inbreeding.

Behind these arguments, however, a biomedical scientist may fail to hear a concern concrete enough to deny the entire field of reproductive medicine. Before the advent of modern medicine, was human, especially infant, life indeed valued more than it is today? Long before unclaimed embryos languished in freezers, most societies practiced disposal of unwanted progeny. In the time of Socrates, unwanted infants were exposed on the Acropolis. In Rousseau's France, they were left to foundling homes with 90 percent mortality. Today we abhor these practices, but we do terminate pregnancies—a practice unavailable safely in previous times—and we argue about the rights of a week-old ball of cells. Might this be considered moral progress? Today, organ transplant physicians make life-or-death decisions based on the lack of donors—and desperate patients go to China to buy organs from executed prisoners. Would stem cell replacement organs offer an improvement?

In *The X-Files, The Postmodern Prometheus*, Scully and Mulder eventually capture the fly-gene monster. In the end they release him in a night club in the Big City, the ultimate American refuge for outcasts and everything new and strange. Will the Big City welcome human clones? Let's hope we work this one out before artificial wombs and AIs make tomorrow's headlines.■

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Note: Portions of this article were published previously in the Observer at Kenyon College.

About the Author:

Joan Slonczewski teaches molecular biology at Kenyon College and studies *E. coli* survival in extreme acid. Her science fiction explores future medicine, nanotechnology, and alien sexualities. *Brain Plague* (Tor, 2000), a Nebula nominee, shows intelligent alien microbes that enhance human brainpower—at a price. Her Campbell-award winner *A Door into Ocean* (Tor reprint) creates a world covered entirely by ocean, inhabited by an all-female race of humans who use genetic engineering to defend their unique ecosystem. In *Daughter of Elysium* (Avon, 1993) biologists engineer humans to live for thousands of years, then face a revolt by the machines that made it possible. She is currently authoring a major textbook, *Microbiology: A Genomic Perspective*, which will include science fiction themes.

All great ideas are dangerous.

—Oscar Wilde

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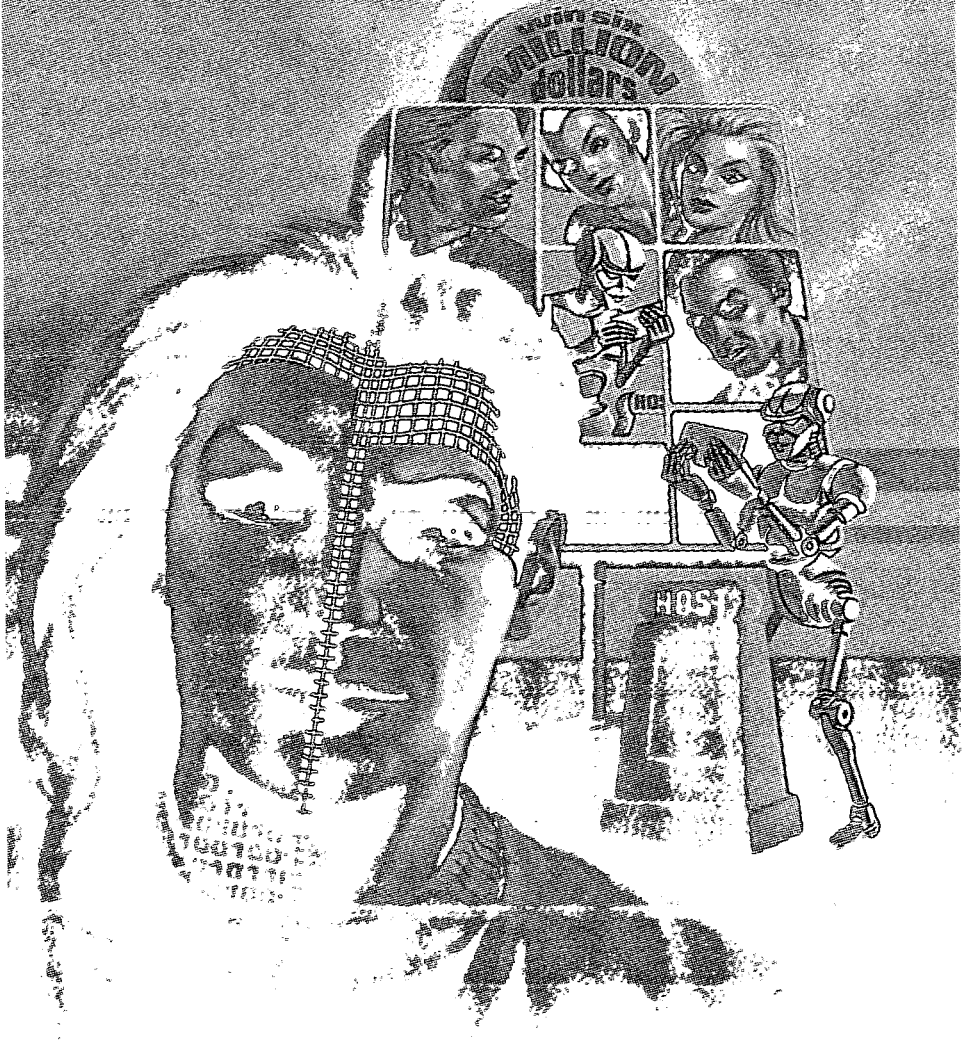
It's Only Human

Brian Plante

Illustration by Charles Bernard



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Round 1

The people on game shows are morons. That's why I'm on *It's Only Human*. No, wait, that doesn't sound right. I mean the *other* people on game shows are morons, not me. I always tell my wife Maureen how stupid those contestants are, and how I could probably do better. One night while we were watching holovision, she dared me to try out for it, and I did. The competition is keen to get on one of the big games like *It's Only Human*, but I passed all their on-line tests, and then a couple of auditions, and here I am. The familiar theme music plays and the game board comes up on the screenwall before me, giving me my first look at the other six contestants. I am Player 5, and my face appears in the lower left screen. My name is Paul Creque.

Director [TO all]: Everybody ready. 10 seconds.

The message appears on the datascreen built into the desk where I am sitting. You don't see the datascreens when you watch the game on holovision, but the players can send each other messages on it while the game is in play. I am nervous and fidget as the theme music ends. My hands are cold and clammy.

"Welcome to *It's Only Human!*" says Newman, the host, from the seven-sided center screen, in the middle of all the player screens. Newman is a robot and looks like it. I've seen good robots that you had to look twice at before you could tell, but the host of *It's Only Human* is purposely built to look artificial, perhaps to emphasize the humanity of the competitors. He looks up, down, left, right—as if he can see each of the players in the individual screens around him on the screenwall. That looks good on holovision, but is pretty stupid when you think about it.

The soundproof booths we are in are not really arranged in the heptagonal setup you see on holovision. We are behind seven doors on a long hallway in the broadcast studio. I am in booth five. I don't know where they keep Newman.

One of the player booths is empty, and the computer-generated Sham Man plays the part of the missing competitor. That's the gimmick on *It's Only Human*—one of the contestants is not real. The point of the show, if you are one of the few people who do not watch holovision, is to pick out the Sham Man. The jackpot is six million newdollars, to be shared by each of the winning players. If the Sham Man is eliminated in the first round, the six players split the six million, but that has never happened yet. The Sham Man is always convincing enough to survive to the later rounds, and only a few players ever really take home any money. But like I said, most of the people on these game shows are morons, so I should stand a much better chance.

"You all know the rules," Newman says, "so let's play."

Player3 [TO all]: Hello everybody. Good luck!

The message from Player 3 strikes me as disingenuous. We are all here to win the money and are competitors, not buddies. I look on the screenwall at the far right. Player 3 is a perky blond, maybe in her mid-twenties. Her makeup is somewhat overdone, and her blouse looks a bit cheap. I make a mental note that she might very well be the Sham Man.

Player7 [TO all]: Ditto.

Player 7, in the upper left corner of the screenwall, is a young man, perhaps twenty. His cheeks and forehead are artificially contoured with the increasingly popular subcutaneous implants. Personally, I think these implants are a grotesque fad, and these kids will all be sorry when they get older and have to have them surgically removed, but then, that's the point, isn't it? Young people will always find ways to assert their independence and shock their elders. I doubt such a nonconformist as this could be the Sham Man, but it wouldn't

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be the first time the computer has gone contrary to the usual strategy and come up with a character that is so unusual that no one would suspect him of being the Sham Man.

"Round one," Newman says. "If money were no object, what planet or habitat would you like to visit, and why?" On the screenwall, he looks upward, and adds, "Player 1, start us off!"

In the screen directly above the host, a thirtyish woman looks a bit like a deer caught in the headlights. I am nervous too, and grateful that I won't be called on right away, but I look at my image on the screenwall and I don't think I look too bad. Maybe that's not a good thing. I'm nervous, so I *should* look nervous. I don't want people to think I'm the Sham Man.

"Uh, how about Middle-Earth?" Player 1 says. "From the *Lord Of The Rings* books? Okay, I know it's not a real world, but you didn't say it has to be an actual place, did you? I just loved those books when I was a kid, and I used to imagine I was a hobbit—those are the people who lived there. It was a very magical place, and I think we all need a little bit of magic."

Player7 [TO 2 3 4 5 6]: Jeez, is she for real?

"Middle-Earth?" Newman says, rolling his mechanical eyes and screwing up his mouth as if he smells something rotten. "All right, then. Player 2, can you come up with something interesting?"

Player 2 is an older guy, maybe sixty. He's had a bit more time to prepare an answer and looks confident.

What will I say, I wonder, when it is my turn? Tyvola is supposed to be a nice planet. They have lots of water there and you don't have to wear any special breathing apparatus. I'll say Tyvola.

"I'd like to go to Tyvola," Player 2 says. Dammit. "They have lots of nice beaches there, and the air is supposed to be real sweet. I once read that the biggest native animals are like puppy dogs, and they'll let you pet them if you don't startle them. After Earth, I think Tyvola would be the next best place in the Universe."

Player7 [TO 1 3 4 5 6]: That's so weak.

I type into the keyboard, *[TO 7]: SHUT UP!*

Almost immediately a message comes back, *Director [TO 5 7]: It's allowed.*

"Yes, Tyvola," Newman says. "The jewel of the Carina arm of the Milky Way. Of course, you're a bit on the old side for such a long trip, Player 2, but we can all hope, can't we? Player 3, your turn. Where would you like to go?"

Player1 [TO all]: I'm sorry I sounded so stupid. Couldn't think of anything to say. I'm not the Sham Man.

Player7 [TO all]: Like you'd say if you were.

I type, *[TO all]: It's just nerves.*

Player 3 is the perky blond who wished us all good luck, so I already have good reason to suspect she is the Sham Man.

"I love skiing and I'm sort of a snow bunny," Player 3 says, "so I think I might like to go to Europa. The pictures look so pretty, what with all that ice, and the domes look kinda cozy. I could just picture myself skiing down those long frozen slopes. I really love the cold weather."

"I'll bet you do," Newman says. "It's 260 degrees below zero on Europa!"

Player7 [TO 5]: Nerves, hell—she's stupid, too.

I type, *[TO 7]: Okay, I'll give you that one.*

"Player 4, where do you want to go?" says Newman.

I realize my turn is coming up next. What will I say? I look at my image on the screenwall, and see my hair is sticking out on one side. I try to brush it back nonchalantly with my sweaty hand.

Player 4 is a stern-looking woman, fortyish, with a severely short haircut, man-tailored shirt, and little or no makeup. Even *I* am wearing makeup, as the production people applied some pow-

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der to keep down the shine of my nervous perspiration before leading me to the booth. Player 4 must have refused the makeup people. She is not the most feminine-looking of the contestants.

"Artanzia," Player 4 answers. "It's a rugged world, out there on the fringe. A person can make whatever rules they want in a place like that. I like to make my own rules."

"Out there on the fringe, are we?" Newman says.

Player7 [TO all]: Newman's a creep.

I type, *[TO all]: Ditto.*

"Player 5, where shall we send you?" says Newman.

"The Moon," I answer. "I know it's desolate, but I like the fact that you can always look up into the sky and see the Earth. I don't think I'd be too comfortable on a world where you need a telescope to see home. Guess I'm not much of a traveler."

I look at the datascreen to see if Player 7 has something nasty to say about me, but the screen remains blank. On the screenwall, I see that Player 7 appears to be typing, but if so, he omits me from his list of recipients.

Player1 [TO 5]: That was nice.

I type back, *[TO 1]: Thanks.*

"The Moon's a harsh mistress," Newman says, "if you like that sort of thing. Player 6, where to?"

Player 6 is a stunningly beautiful woman, late thirties, with a stately manner. Her face looks somewhat familiar. Where Player 3 has an artificially attractive look about her, Player 6 is the real thing. Everything about her, from the expertly coifed black hair, to the makeup-that-looks-like-none complexion, to the rich, emerald-green silk blouse says class. She's almost too good-looking for me to believe she's *not* a clever disguise by the Sham Man.

"I'd go to Sigma Draconis," Player 6 says. "When I was young, I fell in love with a boy who dreamed about traveling to the stars. He used to tell me how he was going to build a new world. I thought it was just stories, but he entered one of the off-world academies and trained to go out there. Sigma Draconis is where he went. I don't really know too much about the place, but I always wondered how things might have turned out if I had stayed with him."

Newman smiles, which instantly makes Player 6 a suspect.

"A long-lost love—how sweet," the host says. "And you, Player 7—you've had plenty of time to think about it; where would you go?"

"Out on one of the generation arkships to the galactic center," Player 7 answers. "I'd rather not know where I'll wind up than go some place humans have already been. It's all about discovery, and the thrill of being somewhere first. That's the real adventure."

"The proverbial slow boat to nowhere," Newman says. "Well, we've heard each of our contestants answer the first question. Six million newdollars are up for grabs. Let's see if they can guess on the first try which one of them is the Sham Man. We'll take a short break and return with the group's decision."

The inane theme music begins playing, and Newman freezes in place. On the datascreen, a message appears, *Director [TO all]: We're in commercial. Decide who you want to vote off.*

Who is the Sham Man? Player 1 is very nervous and came up with a stupid answer, "Middle-Earth." Even the Sham Man wouldn't have come off so lame, would he? Player 2, the old guy, seems relatively ordinary. Sometimes the Sham Man masquerades as a plain-vanilla type like this. The snow bunny, Player 3, seems incredibly shallow, in both her looks and her answer. Perhaps the Sham Man has concocted a patently artificial-looking personality to throw us off the trail. The Sham Man is famous for that—the double ruse, where someone is just so phony-looking that you immediately have to dismiss them as being too obvi-

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ous. Player 4, the masculine-looking woman, is probably just that. Player 6 is far too beautiful to be real, which is probably a dead giveaway that she *must* be real. The Sham Man is master of the fake-out and is rarely quite so obvious. The kid, Player 7, is too cynical. It could be a Sham Man affectation. Then again, I might want to vote the punk out just to put an end to his distracting messages.

I type, *[TO all]: I think it's 3—she looks too artificial.*

Player7 [TO all]: Maybe.

Player3 [TO all]: Hey, sweetie, love ya too. But it's not me. Could it be you?

Player1 [TO all]: I agree about 3. Nobody wants to go to Europa.

Player3 [TO all]: Hey, I can read this, ya know. What about Little Miss Middle-Earth? Like that wasn't the dumbest thing.

I type, *[TO all]: I think she was just nervous.*

Player6 [TO all]: 5 makes sense. I think the snow bunny is the Sham Man.

Director [TO all]: 10 seconds.

Player4 [TO all]: Number 3 it is.

"Hey, we're back, and it's time to see who the contestants think is the wolf among the sheep," Newman says. "This early in the game, you certainly don't have much information to go on, but nevertheless, players, enter your choice now."

I hit the 3 key on the datascreen. The snow bunny.

"Right," Newman says. "The votes are in, and with five of the six votes cast by our human players, the contestants have decided that the Sham Man is Player 3."

Player 3 winces, and she begins to cry. This is not a good sign. Once the Sham Man is uncovered, he immediately reveals himself and carries the deception no further.

"Unfortunately, Player 3 is human," Newman says. "Her name is Christine Ontek, she's single, and works as a bartender in Chicago. And now she's gone."

On the wall, screen three fades to black. Now there are only six of us. No—make that five of us and the Sham Man. He is not one of us.

Round Two

Player7 [TO all]: Nice going, 5. She was a cutie.

I type, *[TO all]: You all voted for her too.*

Player7 [TO all]: Is it you, 5?

Player4 [TO all]: 5, it was your idea to vote for her.

Player2 [TO all]: Yeah.

I type, *[TO all]: You all agreed.*

"Next question," Newman says. "Tell us, please, your most embarrassing moment. Player 5, we'll start with you, since the only dissenting vote in the last round was cast for you."

Damn. No time to think this one out ahead. My most embarrassing moment? That would be the thing I'd want to talk about least. Which is the point—to show some emotion and prove I'm human.

Player7 [TO all]: Make it good, 5.

"I once sent an e-mail love letter to a woman I was dating," I say. "But I accidentally sent it to everyone in my address book. We were pretty, uh, involved back then, and it was somewhat explicit. For weeks after that, people would point me out in the hallways at work and laugh. I almost lost that woman over the e-mail, but people forgot about it after a while, and I eventually married her. Been married to her for eight years now."

Player1 [TO 5]: That's sweet.

Player7 [TO all]: Don't know if I buy it, 5.

"So then," Newman says, "your most embarrassing moment is a computer glitch? Say, that could be telling. But we'll move along to Player 6; tell us your most embarrassing moment."

Player 6 is so beautiful and calm in the screen alongside mine. Do people like that, if she is real, *ever* have embarrassing moments?

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"When I was younger," Player 6 begins, "I used to do fashion modeling all over the world. Paris, London, Rome. On one assignment, we were at a shoot near Mexico City, and I needed to go to the toilet very badly. There were no facilities available at this location, so the crew urged me to go behind a tree and do my business. A few weeks later, a video showed up on the public net with me, squatting and relieving myself. The Mexican crew had a hidden camera set up. I was mortified."

Player1 [TO all]: People can be such jerks.

Player4 [TO all]: I think I've seen your photos, 6. Well, not THAT photo. You are beautiful.

I type, *[TO all]: Ditto.*

"For once, I am speechless," Newman says.

Player1 [TO all]: Thank God.

"Player 7, you're next," Newman says. "Embarrass yourself."

"Not a problem," Player 7 says. "Might as well tell the whole world, right? Okay, I had a case of HIV5 a few years back, and I had to help track down and tell something like twelve partners I had been with that they had to come in and get their shots. It wasn't very pretty since some of the ladies had, um, moved on and gotten married and such. I had quite a bunch of husbands and boyfriends threaten to beat the crap out of me. And now that it's told on holovision, I guess my shame is complete."

Player1 [TO 5] Do you believe him?

I type, *[TO 1]: I believe he had HIV5, but not that he could find 12 partners.*

Newman turned his face in the direction of Player 7 on the screenwall, and shook his head as if he understood deeply. "Tough luck, Player 7. Better keep it in your pants. Moving clockwise, now let's hear from Player 1."

Player 1 looks a lot less nervous this time around, even though the subject matter is more difficult. I guess she has calmed down after hearing the others.

"It was during my sweet sixteen party," Player 1 says. "Some of us had been sneaking beers, and someone came up behind me and put their hands over my eyes. My boyfriend was famous for doing 'guess who?' so I reached behind me and . . . this is really embarrassing . . . tickled his, um, privates. Well, you can see where this is going. It wasn't my boyfriend, but my dad, and that was the end of the party. I was a laughingstock at school for weeks after that."

I type, *[TO 1]: How awful for you. Looks like you turned out okay, though.*

Player1 [TO 5]: Didn't think I'd ever live it down. I guess it's pretty funny now, but not back then.

"Well, you've tickled my fancy," Newman says. "Player 2, please add to our hall of shame."

Player 2 shrugs his shoulders. "Well, I have an embarrassing moment, but, you know, I don't think it's in the same league as the last couple of folks. Back when I was a young man, I was invited to go to a costume party—only it wasn't really a costume party. I showed up at this black tie formal charity event wearing a Binky The Clown outfit. A lot of people thought I was being disrespectful to the charity, but it was just a bunch of my buddies having some fun at my expense. It was plenty embarrassing at the time, although it doesn't sound like much compared to some of you others. You guys have my sympathy."

Player7 [TO 1 4 5 6]: Whattya think? 2's answers are just too pat. Like I said, he's weak.

I type, *[TO 1 4 6 7]: Yes, he could be the Sham Man.*

"Thank you, Binky," Newman says. "Player 4, finish this one off. How low can you go?"

"I was giving a talk to a seventh grade class at career day," Player 4 begins her answer, "describing what it's like to work as a data archeologist. After speaking for a few minutes, I noticed a few kids in the back laughing and passing papers back and forth. I walked back and

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grabbed one of the papers and it was a drawing. Of me. It a was pretty fair caricature. In the drawing, I was . . . with another woman, who I later learned was supposed to be one of the gym teachers at the school. Back then, I was pretty sensitive about my orientation, and I ran out of there crying. That was a stupid thing to do, and I'm really embarrassed more about how I reacted in front of the kids rather than that silly drawing."

Player7 [TO all]: You tell 'em, sister.

"And that's the end of round two," Newman says. "We'll be right back to see if our contestants can pick out the Sham Man. Can you?"

Director [TO all]: Commercial, 60 seconds.

Player7 [TO 5]: You think it's 2, don't you?

I type, *[TO 7]: His answers are so-so.*

Player7 [TO 5]: Tell the others.

I type, *[TO 7]: I'm not saying anything. Last time I was wrong. You tell them.*

Player7 [TO all]: 5 thinks it's 2!

I type, *[TO all]: I didn't say that.*

Player1 [TO all]: Who do you think?

Player2 [TO all]: It's not me.

Player4 [TO all]: 6 had the most embarrassing story, so she's probably okay.

Player6 [TO all]: Thank you, 4. You, too.

Director [TO all]: 10 seconds.

Player7 [TO all]: 5 thinks it's 2. He can't be wrong all the time.

I type, *[TO all]: No, I'm voting for 7. Even if he's not the Sham Man, he's a bully and doesn't deserve the money.*

"And we're back," Newman says. "Contestants, let's see if we can unmask the Sham Man. Cast your votes now."

I press the button for Player 7. On the screenwall, the other players reach forward to punch in their votes.

"All the votes are in," Newman says. "The five remaining human players have cast three votes for . . . Player 7. But I'm afraid you've got it wrong again. Player 7 is Kirby Hogan, a twenty-year-old junior, majoring in Political Science at the State University of New York at Stony Brook. And now he's gone."

Player 7 flips us the bird as his screen fades to black. I am not sorry to see him go, even if he is human.

Round Three

I type, *[TO all]: Too bad 7 was human, but that's more money for us.*

Player1 [TO all]: 5, who do you think it is?

I type, *[TO all]: No idea.*

"So, there are two less of you now," Newman says. "That's six million new-dollars split only four ways if you can get it right this time. Next question—if you were the king or queen of the Universe, what would you do? Player 1, we'll start with you."

Player 1 wears a befuddled look on her face. She reminds me vaguely of my wife. Not because she's playing badly, which I think she is, but because she seems like a normal, honest person. Like Maureen. Too honest to be the Sham Man.

"I know it doesn't sound so important," she says, "but I'd make the construction crews on the New Jersey Turnpike work only on nights and weekends, and not during the rush hour when it slows everybody down. I know they have to fix the roads, but they're always somewhere on the pike every week, and once they put the traffic cones down, everything slows to a crawl."

"The New Jersey Turnpike is the center of the Universe, eh?" Newman says.

Player2 [TO 4 5 6]: Do you believe that woman?

I type, *[TO all]: Yes.*

Player1 [TO 5]: Yes, what?

I type, *[TO 1]: Somebody didn't like your answer.*

Player1 [TO 5]: Then they've never been to Jersey.

"Player 2, now you're the king," Newman says. "What are your royal orders?"

Player 2 is an older guy, so it seems pretty natural when he replies, "The Re-

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juvenate drug shouldn't be affordable only to the very rich. It's not fair to keep it from normal people."

"But if you win," says Newman, "you'll be one of the rich people, won't you? Player 4, what do you do as the queen?"

Player 4, the masculine-looking woman, answers, "Most everything on holovision, including this show, is mind-numbing crap. If I were in charge, I'd make holo producers defend the redeeming qualities of their shows in a court of law. Everything should have some cultural or educational purpose."

"I guess I'd be out of a job pretty quickly then, eh?" Newman says. "Player 5, your answer please."

"I read an article on one of the science newsfeeds," I say, "about how the global warming problem could be solved by floating some reflective plastic flakes high in the atmosphere. If that works, a lot of the equatorial areas would become habitable again. I know the arctic will get too cold for most of the people living there, but that's the way the world was before we messed it up, and those people should just be relocated."

Player1 [TO 5]: Good answer.

"Ah, an environmentalist," Newman says. "Player 6, what do you do as the queen?"

Player 6 answers not just like a queen, but like a *beauty* queen: "If I were in charge, I'd promote peace, not just on Earth, but on all the colonized worlds. There should be an end to war, hunger, disease and ignorance. Then all humans will be truly free."

Player2 [TO all]: Thank you, Miss America.

"That concludes round three," Newman says. "Time to find the Sham Man. We'll be right back with the panel's decision."

Director [TO all]: Commercial—back in 60 seconds.

I type, *[TO all]: I'm voting for 6. She looks too perfect.*

Player6 [TO all]: So sorry for looking nice.

Player2 [TO all]: It could be you, 5. That global warming thing was too technical.

I type, *[TO all]: I read it somewhere.*

Player4 [TO all]: You're all so real.

I type, *[TO 1]: I'm voting for 6, are you?*

Player1 [TO 5]: Okay.

Director [TO all]: Time.

The music begins playing, and Newman takes his cue, "We're back, and the players will now try to find the Sham Man hiding among them. Players, please vote now."

I press the button for Player 6.

"The votes are in," Newman says. "With three of the four human players voting for Player 6. But she is Maria Minucci—a thirty-seven-year-old former fashion model, she now runs her own modeling agency in Minneapolis. And now she's gone."

Player 6 gives a sad smile and waves as her screen turns black. Only four of us left now: the woman who reminds me of my wife, the old guy, the manly woman, and me.

Round Four

"Six million newdollars split between only three of you now," Newman says. "But only if you get it right. Next question—tell us who is, or was, your greatest love, and why. Player 2, let's start with you."

Player 2 smiles and says, "Who I love the most? That's easy. I was married to my wife Barbara for forty-four years. I've got a grown son and a daughter, and three grandchildren, and I love them all dearly, but the greatest love of my life was, and will always be, Barbara. She, ah, died last year. But I love her still."

"Very touching, Player 2," Newman says. "How about you, Player 4?"

Player 4 strikes me as the least emotional of the group, but she seems to wither under the pressure of this question. "I, uh . . . this isn't so easy for me.

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I'm not . . . I have a partner, but we haven't been together very long . . . Virginia, I'm sorry, but I just don't know yet if you're the one. My parents . . . didn't approve of my lifestyle. I had a brother I loved a lot. He, uh, committed suicide when he was fourteen. Donny, I love you."

Player 4 is crying as she says the last sentence. It is either a very heartbreaking moment, or a clever ploy by the Sham Man.

"Well, another touching story," Newman says. "If I had a heart, I suppose it would be breaking right now. Player 5, who do you love?"

I am not going to be as melodramatic about it as Players 2 and 4. My family is still alive.

"I have two loves," I say. "My wife, Maureen, and my six-year-old son, Andrew. I can't tell you which one I love more. The love for a spouse and the love for a child . . . well, it's not quite the same, is it? I'd lay my life down for either of them, but I won't pick one over the other."

"Very political, Player 5," Newman says. "Going back to the top of the board, Player 1, please tell us of your greatest love."

Player 1 is showing some emotion on her face. "I'm really touched by the answers from the other players," she says. "It's hard to believe one of them isn't real. I'm afraid my answer is going to sound a lot like Player 5's answer, but he beat me to it. I think he and I are a lot alike, really. I have a wonderful husband, Sam, and two great kids, Lilly and Peter. I couldn't pick a favorite. When you love completely, there are no favorites. I love you Sam, Lilly, and Peter."

Player 1 blows a kiss to the camera. Maureen would like this woman. She seems like our kind of people.

"Right, that's the end of round five," Newman says. "Do you think you know who the Sham Man is yet? We'll be right back with the panel's pick."

Director [TO all]: Commercial, 60 seconds.

I type, *[TO all]: This is tough.*

Player1 [TO 5]: Who do you think it is?

I type, *[TO 1]: You mean, if it's not us?*

I feel pretty sure it isn't Player 1, but you can never really tell. She and I seem the most alike of the remaining players, but for all I know, she's the Sham Man, simultaneously sending private messages to the other two players, just as she's doing to me.

Player2 [TO all]: I'm stumped. Eenie meenie miney mo.

Player4 [TO all]: I think I know who it is.

I do not know who it is, but it looks like Player 1 will vote along with me, so I type, *[TO 1]: I'm picking 2.*

Director [TO all]: 10 seconds.

Player1 [TO 5]: Okay.

The music starts up, and Newman comes back to life. "Things are getting tougher and tougher, aren't they? Players, please indicate who you think is the Sham Man now."

I push the button for Player 2.

"We have a decision," Newman says. "Two of the three votes say the Sham Man is Player 2. Unfortunately, Player 2 is Walter Wagner, a sixty-three-year-old retired law-enforcement officer. Walter has two children and three grandchildren, and he lives with his wife in Boise. And now he's gone."

Player4 [TO all]: He lives with his wife? The bastard said she was dead!

Apparently, Player 2 was trying to improve his chances by drumming up a little sympathy. Even though he is human and not the Sham Man, I don't feel bad for having voted him off. Now it comes down to the three of us. Player 1, so much like my wife, like me. Player 4, a hard life and a good story. Who to kick off next?

Round Five

I type, *[TO 1]: Do you trust me?*

Player1 [TO 5]: In for a penny, in for

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a pound.

I type, *[TO 1]: Then we vote for 4, no matter what. It has to be her.*

Player1 [TO 5]: Okay.

Player4 [TO all]: I can see you're both typing, but not to me. I swear I am not the Sham Man.

"Only three of you left," Newman says. "Surely by now, the two humans among you must have a good idea who the Sham Man is. Your question: assuming you do actually win the jackpot, how would you spend it? Player 4, we'll start with you."

"I'd keep some of it for my partner and me," Player 4 says. "Maybe about half. The rest, I'd give to charity. I've done some work with abused kids, and I'd like to donate the money in my brother's name."

I type, *[TO 1]: It's a ploy. She's pouring on the sympathy.*

Newman says, "And you, Player 5? How are you going to spend your millions?"

Just be honest, I tell myself. It doesn't really matter, since Player 1 and I are both going to vote for Player 4. The fix is in.

"I'd buy a nice house for my wife and kid," I say. "A new car, a bigger screen-wall, some real wood furniture. Maybe take my family on a fancy vacation. I probably would keep working for a while longer just to keep busy, but it would be nice to know I didn't have to. I'd be able to take things easier and spend more time with my family."

"More time for the family," Newman repeats. "Player 1, how would you spend the money?"

"Yes, definitely a nicer house and a bigger car," she says. "I'd pay off some debts, give some of it away as gifts to a few friends and family, and invest what's left over. Oh yeah, maybe I'd spend a little getting my family together with Player 5's family. I think we have a lot in common."

"You're sure of that, are you?" Newman says. "We'll find out, right after this brief message."

Director [TO all]: 60 seconds.

Player4 [TO all]: I am a real person. I don't know which of you is the real one, but I am not the Sham Man.

I type, *[TO 1]: Don't listen. Of course she'd say that.*

Player4 [TO 5]: It looks like you're typing to her. Are you real? I swear, it's not me.

Fifteen seconds go by, and I receive no messages.

Player4 [TO 5]: She's playing you for a fool, 5, pretending to be so much like you that you'll think she's human. I'm not the same as you, but I am not the Sham Man, so it has to be her. Will you vote with me?

Director [TO all]: 10 seconds.

I don't type any more.

"Welcome back, everybody," Newman says. "We're coming down to the wire now. Players, make your pick."

I don't hesitate. I stab at button 4 with my finger.

"The votes are in," Newman says. "And it's a standoff. One vote for Player 1 and one for Player 4. You at home must break the tie. Please enter your votes now."

Player1: [TO 5]: Oh no, please, not me.

I cross my fingers, hoping the home audience will pick correctly and vote off Player 4. She must be the Sham Man. But if she is the Sham Man, then she has cast no vote. I voted for Player 4, and Player 1 voted for 4, so who voted for Player 1? It could only mean . . . .

"The audience vote is in," Newman says. "And with 53 percent of the total, the audience has chosen Player 4. But she is indeed a human. Her name is Nikki Holterman, forty years old, and she is a data archeologist in the Dallas area, where she and her partner make their home. And now she's gone."

Round Six

Player 4 was human. I am stunned. If she was not the Sham Man, then Player

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1 *must* be. I know I'm okay, so it has to be her. Player 4 was right, she played me for a fool all the way, and I fell for it hard.

I guess I was right all along: the people on game shows *are* morons. Like me.

"For our final round," Newman says, "you, the home audience, will vote again. Pick correctly, and a fellow human being wins six million newdollars. Pick the wrong one and the Sham Man wins yet another week of *It's Only Human*."

The Sham Man wins nearly every week. 92.5 percent of the time, to be exact. Even though there are six million newdollars up for grabs every week, the show has paid off only twelve times in five years. 1,190 human players, and only twelve of them were human enough to be convincing.

How do I know these statistics? I have watched the game on holovision, but not studied it. Could *I* be the Sham Man? No, I remember them leading me in to the studio and putting makeup on me. Before that, I drove . . . how *did* I get to the studio?

I have a wife. Her name is Maureen. She was the one who said I should try out for *It's Only Human*. What's her maiden name? I should be able to remember my wife's maiden name. It's . . . it's . . . .

My son is Andrew. We call him Andy. He's six years old and in the first grade. His teacher's name is . . . his friends are . . . I don't know. Why don't I know? Are all my memories false?

I am the Sham Man.

Player1 [TO 5]: It's you.

I type, *[TO 1]: Yes. I didn't know until just now.*

"Your final chance, Players," Newman says. "Speak to the audience. Prove to them that you're a human being. Player 1, we'll start with you. You have thirty seconds to plead your case."

Player 1 looks quite emotional. Perhaps she is angry with me for playing the game so well. I feel guilty. Should the Sham Man feel guilty for having deceived? I didn't know until a few moments earlier that it was me. But that is my purpose in the artificial life I live. This week I am Paul Creque, a thirty-six-year-old advertising agent with a wife, Maureen, and a son, Andy. Next week, I might be a little old lady, or a truck driver. I won't remember this. It is what I am meant to do.

But why am I feeling guilty about it now?

The programmers seem to leave little to chance. My success in deceiving the players and the audience in past shows is proof of that. Am I *supposed* to feel guilty coming into this final round? It seems an error that I would know who I am before answering the final question. Could the programmers have made a mistake this time?

"I'm pissed off," Player 1 begins her final pitch. "At your Sham Man and myself. I thought I had a buddy, right up until the end. He seemed like such a nice guy. What a jerk I was, huh? The Sham Man used me, to make me vote for whom he wanted, and I feel sorry for all the other players who lost because of my gullibility. But you need to know that I am human, and Player 5 is the computer. Look—"

Player 1 lifts her arm up to her mouth and bites down hard on the skin of her forearm, drawing blood. She is crying.

"See, I bleed. Yeah, it could be just another trick from the oh-so-clever Sham Man, but what more can I do? Tear my hair out? Gouge my eyes? This is just a stupid game, and if you can't pick out who's the human, then you're all the losers."

"Time's up, Player 1," Newman says. "Your turn, Player 5; state your case."

"Let's say that I'm the Sham Man," I say levelly. "The lady isn't lying—she really is the human. I could bite myself, too, and make the image look like I'm bleeding, but why bother? She's the winner. This is such a cruel game, I'm

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ashamed to be a part of it. Give the lady the six million, and then turn off the holovision. I am disgusted by this whole thing."

"Well, that's certainly an unusual tactic," Newman says. "But you at home must decide, is it Player 1, with her impassioned appeal, or Player 5, perhaps with a bit of reverse psychology? Vote now, and we'll be right back with the results.

Director [TO all]: 30 seconds.

I send a message directly, without having to go through the charade of typing, *[TO 1]: Congratulations, you win.*

Player1 [TO 5]: Thank you. You fooled me completely.

I send back, *[TO 5]: Sorry, it's my job.*

The music plays and we're back on the air. Newman opens an envelope and extracts a sheet of paper. This is just a bit of showmanship, as he is really reading the tally on the datascreen in front of him.

"Ladies and Gentlemen, by a vote of 96,349,021 to 95,288,310, you have selected Player 1. Unfortunately, like so many weeks before, you have selected the human player. She is Dorothy Burt, a stay-at-home mom from Edison NJ, where she lives with her husband Sam and children Lilly and Peter. And now she's gone."

Just before screen one darkens, I see her face, a mask of shock. Even though I have tried to give the prize away at the end, the audience did not believe me. Perhaps they have second-guessed themselves, assuming that if I am trying to throw the contest, then I could not possibly be the Sham Man. My programmers seldom leave anything to chance, so that is how they must have planned it all along. Human psychology is confusing, but simple to program for large numbers of subjects.

I morph my video face to the demonic Sham Man image that you all know, and smile cruelly as the credits roll.

Director [TO 5]: Good show. Even I thought it was her.

I hope next week they don't program me with guilty feelings again. I don't care if I lose. I just want to be a happy person next time.

But I won't remember any of this, will I? ■

MOVING?

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TOWER OF BABEL

Grey Rollins

When does an aid become a handicap?

Ethan Forbes slid to a stop just in front of Karen Abercrombie's desk. "I gotta talk to Mike, right *now!*"

Karen gaped at him, astonished to see a normally quiet, well-behaved coworker acting as though his pants were on fire. "What?"

He was grinning like a madman. "Gotta tell Mike about the TransVox circuit! We finally finished it!"

"But, Ethan, he's got a meeting in less than ten minutes."

"No problem—I'll talk fast." Given the way he was acting, he'd gladly recite the collected works of Shakespeare in less than ten minutes, just for practice.

Frowning slightly, Karen pressed the button on the control panel in front of her. "Sir, Ethan Forbes is here. He'd like to report to you on the TransVox project."

There was an ominous moment of silence before Michael Snead replied. "He does understand that I've got a meeting, doesn't he?"

"Yes, sir. He says he only wants five minutes of your time."

An exasperated sigh issued from the speaker. "Very well. Send him in."

Karen gave Ethan a pitying look. "I'll dance at your wake."

Dinner at the Snead residence that evening was accompanied by the usual mixture of quiet conversation about the small things that had happened during the course of an ordinary day, interspersed with mushmouthed contributions from their teenaged daughter. It was a continuing source of annoyance to Michael that his wife, Beth, condoned their daughter's lack of enunciation, but his attempts to get her to crack down were always met with oblique comments such as, "I understand her perfectly, dear," invariably followed, after a discrete interval, by the suggestion that perhaps he should get his hearing checked. Michael was certain that the

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problem wasn't his hearing, as he never had trouble discerning what anyone else was saying. It was the fact that their daughter had never grown out of a habit of speaking in baby-talk. Since she was now thirteen, she should be well past any such tendency, but as long as she had her mother's implicit permission to speak as though she had a mouth full of marbles, she wasn't going to get any better.

This dinner was no exception.

"Canna haf da sal?" Martha mumbled.

Michael frowned. "What did she say?" he asked his wife. He knew better than to ask his daughter, as that would only produce a verbatim repetition of the same slurred syllables. He depended on Beth to interpret.

"She asked for the salt," his wife said, pointing at the shaker in front of him as though he had expressed ignorance as to what salt was.

His mouth twisted in irritation as he passed the shaker. "If she doesn't learn to speak English soon, she's going to have an awfully hard time as an adult. What will happen if she asks for the salt and you're not there to translate?"

Beth looked at him as though he was slightly daft. "There's nothing wrong with the way Martha talks."

Rather than make an issue of it, he sighed and went back to his meal.

"Mom, I deci I doan wanna go to da mofee wi Bil afar all. Ya kno how he wa messin wi Susun? He wa doin it agin taday. I thaw him inna hall talkin wi er, an bein real clos an all, an I as him abou it and he sa da he wuzn doin nuthin. Ba I thaw hith hanz on er . . ."

It was nothing more than gossip to Michael, anyway. The trials and tribulations of being a teen had been bad enough the first time. He felt no need to relive the trauma vicariously. However, he understood enough of the swirling, muddy currents of malformed words to catch the drift of the problem.

"Perhaps Bill's tired of going out with a girl who refuses to speak English. Maybe he can understand what Susan is saying," he muttered, just loud enough to be heard, but not so loudly that they couldn't ignore him if they chose.

From the pained look his daughter gave him, he knew the barb had struck home. Whether her boyfriend was or was not able to understand her, she knew a shot had been fired across her bow.

After a brief pause, mother and daughter went back to talking, acting as though he wasn't even in the same room. It was insulting to be left out, but he couldn't keep asking for interpretation from Beth. A sudden thought occurred to him. Patting his pockets, he located the prototype circuit Ethan Forbes had given him that afternoon. Without saying anything, he flipped the switch and set it on the table midway between his place and Martha's.

". . . an den I saw em kissin affa lunch an—"

". . . and then I saw them kissing after lunch, and—" the chip confidently translated.

Both mother's and daughter's heads snapped around to stare at the offending piece of electronics. *"Wuzzat?"* Martha demanded.

"What's that?" the circuit cheerfully repeated.

"That," Michael said evenly, "is a new circuit we've been working on. It's a prototype, but I think it's promising. The idea is that it will translate between English and any other language, automatically."

A skeptical look crossed her face, but she turned back to her mother. "Anwa, dey wer kissin an he ha hiz hanz up her sweder—"

"Anyway, they were kissing, and he had his hands up her sweater—" the circuit supplied.

Michael's eyebrow rose sharply. "Um, Martha . . . I'm not sure I want you seeing this boy any more."

Her eyes were frozen in horror on the offending circuit, but that changed to

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hostility as they rose to meet his. Belated realization dawned upon him—he had committed the unpardonable sin of breaking the code mother and daughter had previously considered to be their private mode of communication. He was going to be in the doghouse for a while.

"Bu Dadda!"

"But Daddy!"

"You're a bit young to be going out with a guy who can't keep his hands to himself."

"Bu . . ."

"But . . ."

And the conversation stopped dead. Absolutely dead. Both mother and daughter ate in cold, stony silence from then on. Michael missed the conversation, but he didn't miss the mumbling. Viewed objectively, it wasn't all that different from being treated like a piece of furniture prior to bringing out the TransVox. All in all, a decent tradeoff.

The school board was between a rock and a hard place. Due to the increase of Hispanic children in the city, a third of whom spoke little or no English, they were in a bind. They were responsible for educating those students, regardless of their language skills, but to do so, the school district would have to hire Spanish-speaking teachers to create a parallel, redundant curriculum, while simultaneously trying to teach them English from the ground up in separate, dedicated classes. And, with the perversity of all bad luck, the situation had reached crisis proportions in a year in which the school district was facing a 15 percent budget cut.

"I have no quarrel with the Mexicans and Puerto Ricans being here," the superintendent said to her secretary. "They're honest, hard-working folks who ask nothing more than to settle into the community and make a living. But I wish they'd take it upon themselves to learn English, rather than show up and wait to be taught." She smiled bitterly. "How in blazes am I supposed to get the job done with the budget they allow us?"

The question was rhetorical, and they both knew it. Education boards all across the nation were faced with similar problems. Their situation was hardly unique.

The secretary, however, had a card up her sleeve. "Ma'am, I have a letter here that might be of interest."

"I'm open to any reasonable suggestion," the superintendent growled, holding out her hand for the letter her subordinate was passing across the desk. She read the letter, glanced up and said, "Make an appointment with their salesman. This just might do the trick."

Michael Snead was positively glowing. TransVox sales were through the roof, and all on a gadget that he had first dismissed as a product with only niche market appeal. He had long since forgiven Ethan Forbes for making him late to his meeting that day. In fact, he had given the poor fellow a raise. It was the least he could do after the bawling out he'd given him. It did his heart good to see Ethan in his shiny new sports coupe, waving jauntily at Karen as he pulled into the parking lot.

Niche market, indeed.

More like *hundreds* of niche markets.

Foreign nationals on vacation no longer had to slog through the vagaries of English to order a meal in a restaurant. As a result, tourism was up.

Diplomats were assured that their meaning would be precisely conveyed in negotiations. International tensions were at their lowest level in years.

Inner city kids, accustomed to speaking a constantly shifting lingo all their own, could now be understood by the man on the street. Law officers and common citizens alike welcomed the improvement in communications. While the kids themselves weren't exactly overjoyed, having taken great pains to isolate themselves from the rest of soci-

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ety, the fact that many people carried a TransVox now as a matter of course had led to somewhat better dialogue over troubling issues.

And, of course, there was the teen segment. Martha had finally accepted the TransVox as a useful toy, especially after all her friends began carrying them. Granted, her personal speech patterns had degenerated to the point where even her own mother couldn't understand her, but it was a controllable problem. They kept translators in strategic locations around the house so everyone could communicate on a day-to-day basis. Martha's friends, and indeed teens worldwide, were developing gradually diverging individual speech patterns, to the point that each child had created a mode of speech that verged on being an independent language. But as long as there was at least one TransVox handy, they all got together and chatted the way teenagers have ever since language was invented. The only common vocal element they still shared was giggling, the universal sound.

Finally, in an unforeseen development, it turned out that infants were able to formulate coherent vocal communication much earlier than anyone had thought. Their formerly meaningless expostulations were deciphered and rendered into plain English long before the first intelligible "mama" was uttered. Granted, conversation consisted mainly of rather basic human desires such as food and sleep, but the fact that they were able to communicate at all led to much lower levels of stress. No longer were parents tearing their hair out wondering why their baby was crying. The child told them. Psychologists were falling all over themselves writing papers painting rosy pictures of a future where children grew up well-adjusted because their basic needs were being met more effectively than ever before.

The fact that they were no longer learning to speak anything remotely like traditional spoken language was brushed off as unimportant. The paramount thing was the mental health of the child. They could always use the TransVox to communicate.

But Murphy's Law had not been repealed. . . .

Within five years, everyone carried a TransVox as a matter of course. The basic function remained the same as the very first model: The TransVox itself was primarily a transmitter, uploading the conversation to massive computers able to sift meaning from anything more structured than the sound of the wind in trees. Any sound, rendered from its original utterance, be it English, Spanish, Swahili, or childish mush, was then sent back to the originating TransVox in a form that matched the speech patterns of the listener. Life was moving along smoothly for everyone.

Until Herman Underwood hit the enter key.

Herman had not been dropped on his head as a child. Nor had he been deprived of basic nutrition. He was simply one of those people who needed human contact. Real, actual human contact. Not the arm's length variety provided by the ubiquitous translator circuits. Although he couldn't have expressed it in quite such precise terms, he wanted to talk to somebody . . . anybody. About anything. He just needed to hear a human voice that he could understand—not the synthesized voice of a TransVox.

As a result, he had grown up a little different. Not so much that anyone would notice, just that one tiny, little bit that made a difference. He hadn't gone so far as to identify the TransVox as the enemy, but he was vaguely aware of an itch in his psyche in the area where language would be for a normal child. In a fit of misguided creativity, he wrote a computer virus. One that wouldn't trigger for six weeks—more than ample time for it to upload and download the countless times that would allow it to infest every TransVox on Earth, and each

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and every one of the main translation computers.

Michael Snead became aware of the problem at the same time everyone else did: 7 A.M. on Monday, May 11th. Breakfast was scrambled eggs and bacon, with toast. Life seemed normal.

"Dad, I've got a play tonight at school. Do you want to come?" Martha asked. Not Martha, herself, of course, but Michael had long since learned to ignore the background mumbling that issued from his daughter's mouth. It was the TransVox's pure, clear English that he heard.

He considered for a moment, then said, "Sure. Love to. What time will it be?" Well, actually, that's not what he said, either. To tell the truth, in the last few years, his own speech patterns had gotten a little lazy. More truthfully . . . a *lot* lazy. Michael Snead had become as addicted to the TransVox as his daughter and everyone else.

"The play starts at eight, but I need to be there by at least seven-thirty so I can get into my costume. Mom made it an I wan ya ta see id, iz rally somfin niffy . . ."

Martha's voice trailed off as she stared in consternation at the TransVox on the table. "Whazza madder wid id?" she demanded.

Michael shrugged and pulled his out of his pocket. He had the fancy executive model, but really, although the fact wasn't widely advertised, it had the same innards as his daughter's, just with more lights and a sleek, trendy carbon fiber shell. He said, "Doan wurry hony, I'll brin ya a new wun hom thiz affernun."

Obviously, his wasn't working either. All his family heard were the actual words that slouched out of his mouth, and although his wife was somewhat able to follow what he said, she didn't catch all of it. Her own speech patterns had drifted towards something like an unholy hybrid between French and deep-fried Southern. "We'all, led moi troi moine," she said, which made no sense at all to either husband or daughter. After she'd tried five times at steadily increasing volume, on the time-honored theory that if someone doesn't understand you, say it again louder, her husband placed his hand on hers and shook his head.

"Iz nod wokin, hony. Wherz sum papur?"

He didn't need her puzzled frown to know that he hadn't made himself clear. He was on the point of repeating himself more loudly, but stopped. Best not to fall into the same trap. Grumbling in a private language of cuss words known only to himself, he pushed back from the table and went in search of a pad of paper.

Fortunately, everyone still knew the same alphabet and words were still spelled the same, or they'd have been in far worse trouble.

By the time he got to the office, he knew he was in deep trouble. *Everyone's* TransVox had quit. Every single blinking one of them. Someone else had hit on the idea of passing notes, so people were scribbling frantically.

By noon, the trash cans were full.

By 2 P.M., they were out of paper.

Karen Abercrombie came back from the nearest office supply store empty-handed. It soon became clear that paper was in scarce supply everywhere.

By late the next day, the nation and much of the formerly civilized world had ground to a halt.

The superintendent was resigned to her fate. There would be no classes in any subject other than basic English for at least the current school year. In fact, teachers who still spoke clear, unambiguous English were in such demand that they could name their own salaries and many were leaving for school districts bidding more money. She was pressed into hiring retirees and country folks who, out of sheer cussedness, had

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never taken to the newfangled TransVox devices.

Beginning and remedial English. Only. No other classes would be taught until the entire nation dragged itself out of the mire of half-formed words and mangled syllables that it had blundered into. Poor speech had become so ingrained that people could not easily break the habit and return to properly spoken English. It would take time and a great deal of effort.

Pathetic, but there it was.

Herman Underwood sat in class, attentive, even thirsty for knowledge. Speech was being directed at him. Real, human, actual words.

Learning was fun in a way that it had never been before. He was starting to feel that he belonged . . . really belonged.

Until the FBI showed up at the door of his classroom with grim expressions and a warrant for his arrest.

The Snead household had undergone cataclysmic readjustment after Michael's job evaporated. After Underwood's virus had brought the entire TransVox network crashing down, the problem had snowballed into a public relations nightmare. It had taken over two weeks to flush the entire system of the devastating virus. During that time, people reconsidered their dependence on the TransVox. Sales plummeted. As a result, the company hit the wall financially. The doors were locked, and everyone started sending out résumés, hoping for employment in somewhat more stable industries.

Michael Snead, however, had become the scapegoat for the debacle. Every crisis has its cause, and he was the one chosen by fate to take the blame for bringing the world to a standstill. He tried to bear his cross gracefully, but there were still times when it rankled. Looking back, he'd identified the pivotal moment. He was man enough not to point fingers, but he still remembered, oh so clearly, the night he'd placed the very first TransVox on the table . . .

All so he could understand a mush-mouthed teen-aged girl.

And Ethan Forbes?

Well, Ethan Forbes had had an idea. A wonderful new idea. But he would need money to develop it, so he'd cashed out two months before the crash—taken his stock options, sold his house and car, and left for Tahiti for a vacation before plunging into the research necessary to bring his latest idea to fruition.

But for the moment he had no plans. At least nothing beyond the next twenty-four hours. The lovely brown-skinned girl across the table looked at him with adoring eyes. He returned the look with interest.

He couldn't speak a word of Tahitian, and she knew very little English. It didn't matter. He reached for her hand and led the way back to his cabin. Regardless of their lack of verbal communication, they still shared a common language.

The language of love. ■

I finally know what distinuishes man from the other beasts: financial worries.

—Jules Renard

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It's easy to dismiss an experiment that doesn't give the expected result as a "failure," but it ain't necessarily so. . . .

The Cat and the Pendulum

Kathy Oltion

Illustration by Kelly Freas

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"Are you still down there playing in that sandbox?" Eileen called from the top of the basement stairs.

"Honey, I'm *working* on the *pendulum*," Geoffrey called back.

"Yeah, whatever. Lunch in five. And I don't want to see any sand tracked across my kitchen floor. I just mopped."

"Yes, dear," he said, though he knew she'd already moved on and was out of hearing. Since his retirement three months ago, he'd gotten used to some of his wife's habits, but he feared that it would take longer, if ever, to feel like he wasn't a pest underfoot all the time. He understood that the house had always been Eileen's domain, that it would take some effort on both their parts to find a more harmonious way to share their space now that he was home all the time, but he didn't understand her lack of interest in his projects. Especially this one. The work he put into this pendulum could provide some real information for the advancement of science, but she didn't seem to believe him.

Odd, he thought, how people can drift apart so quietly. When they'd met so many years ago at college, they'd hung on each other's words, talked about the science classes he'd taken, the theories he'd learned. In turn, he'd discuss and debate the ideas of literature and psychology that she'd studied. He knew she could well understand what he was so excited about, but it took a back seat to her TV shows, her cards and gossip. He missed those days, those discussions. He knew that he was in part to blame for the state of their lives, that his job had taken so much of his attention. Now that he was retired, he wanted to go back to the way they had been, but he hadn't realized how much inertia he'd have to battle.

With a sigh, he stood up from the sand pit he'd built last week, and dusted off his hands and knees. Maybe this time he'd gotten the linear impulse motor to operate right. He picked up the long-handled hook he'd fashioned from a wire coat hanger and caught the string that dangled from the ceiling over the middle of the sand pit. The lead weight he'd tied to the end kept the string taut. With great care, Geoffrey positioned the weight at the edge of the pit and released it. He watched it swing in its graceful arc, the finely pointed end tracing lines through the sand.

Eyeing his creation critically, Geoffrey scowled at his pendulum. He had to get everything working right before the end of the week, when the total solar eclipse would trace a path right over the house. This would be a once-in-a-lifetime chance for him to perform a real scientific experiment, not just a fun, cookbook parlor trick like so many of his projects. He'd even been in contact with the professors at the state university about his pendulum work. At least *they* seemed excited about it.

Five minutes wasn't going to be enough time for him to do much except watch the pendulum swing, and maybe decide where he was going to place the video recorder. If he mounted it on a board and attached it to—

"Geoffrey!" Eileen called from the stairs again.

"Yes, dear?"

"Bring up a can of tomatoes, would you?"

Geoffrey sighed again. All concentration came to a screeching halt. "Yes, dear." He turned from the pendulum and opened the door to the pantry. Might as well go upstairs now. He wouldn't get a chance to think again until after the lunch dishes were done and Eileen left for her afternoon bridge club. Oh well, at least the pendulum could swing for an hour or so and he'd get an idea of what he needed to do. Where were the tomatoes? Ah, there they were.

With a can of stewed tomatoes in hand, Geoff climbed the stairs. As he reached the landing where the back door opened to the garden, he heard Puffster, Eileen's scruffy yellow tomcat,

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yowling at the door. Without thinking, Geoffrey turned the handle and Puffster shot past his feet, dragging in a wave of icy winter air with him. The cat immediately headed for the basement.

"Hey! No! Come back here, furbutt!" Geoffrey twisted around and ran back down the stairs after the cat. The last thing he needed right now was for his sand pit to become a litter box. They both reached the bottom stair at the same time and Puffster meowed indignantly as Geoffrey scooped him up. *Jeez, how heavy can an eight-pound cat be?* Geoffrey thought. Maybe he'd make a study of how cats can adjust their weight according to whatever activity they were engaged in. Like how lithe and featherlike they were when jumping to the kitchen counter in search of chicken, and how one cat running the length of the hallway could sound like a herd of elephants. How heavy they were when they jumped on the bed at the crack of dawn, wanting to be fed.

He closed the door to the basement and carried Puffster to the top of the stairs. "I don't need you messing up my stuff," Geoffrey said as he deposited the cat next to his water dish.

"I'm *not* going to *touch* your stuff," Eileen said as she placed two plates full of steaming tuna casserole on the table.

"I'm talking to the cat."

"Would you touch his stuff, hmmm? Would you?" Eileen said to Puffster in her talking-to-the-cat voice.

The cat rubbed against Eileen's ankle and meowed.

"Oh, sure. Like he's going to tell *you* his real intentions."

"Did you bring up my tomatoes?" Eileen spooned the chunks of tuna she'd saved for Puffster into his food bowl. The cat greedily nosed his way past her hand and devoured the fish.

"On the counter. I need to go to the lumber yard and get a wider board to attach the camera to."

"That's nice." Eileen picked up the can Geoffrey had brought up. "Oh honey, I wanted *whole* tomatoes. Well, never mind. I'll just go get them myself."

Before Geoffrey could say he was sorry, she disappeared down the steps. With a shrug, he settled at the table and pondered the next stage of his project.

Once he had the camera set up, he'd need to run some tests and make sure it was aimed properly. He would need the tape to validate any claim he made about observing the Allais effect. He chuckled to himself. Two weeks ago, he'd never heard about Maurice Allais or his observation that a solar eclipse had changed the constant swing of Foucault's pendulum. He'd read the brief article in his weekly science newsletter describing how the scientist postulated that his discovery could cast into doubt all we thought we knew about gravity. It could even lead to the development of antigravity!

"You need to see this," Eileen called from the basement.

"What?" Geoffrey asked. With a great sense of unease, he returned to the basement to see a delighted smile on Eileen's face and Puffster on his back in the middle of the sand pit batting at the pendulum. Geoffrey swallowed a groan and said, "Wouldn't touch my stuff, huh?"

"Oh, but he's so cute!"

Sure he was cute, but he'd stopped the pendulum's arc, obliterated the lines it had drawn, and scattered sand everywhere. He clenched his fists, wanting to yell and stomp his feet at the cat. That smile on Eileen's face kept him quiet, softened his anger. Besides, scaring the cat would only cause him to scatter the sand more and make a bigger mess.

Without warning, Puffster jumped sideways away from the weight, shook some of the sand loose from his fur, and ran to the landing, meowing to be let out.

The eclipse started on Friday morning, about 10 A.M. Geoffrey had everything ready to go. He'd started the pendulum swinging when he got up at six that

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morning, and now he could see the distinct pattern of Earth's rotation evolving in the smooth sand. The sky was overcast, and it felt like snow. The eclipse looked to be totally unexciting for the local viewers, but Geoffrey didn't care. He didn't think clouds would affect his experiment.

The video camera whirred quietly, and Geoffrey dictated the events as they unfolded. Eileen sat upstairs in her favorite chair by the bay window in the living room, knitting while she watched some silly soap opera. Puffster was safely outside, no doubt plotting the demise of the chickadees and nuthatches that gathered at the birdfeeder.

As all his work in the last few weeks built toward a conclusion, he felt a sense of unease, a nagging worry that something wasn't quite right.

From upstairs, he heard the familiar creak of the floor as Eileen got out of her chair. "Geoffrey?" she called.

"Yes?"

"Look honey! I think the clouds are breaking up. Maybe we can see the eclipse after all!"

My God, he thought. She's actually interested in what's going on. He climbed the stairs and joined her at the dining room window. He looked out through the bare tree branches at the light gray sky. "I think you're right. There's a hint of blue up there."

"Let's go outside. I'd like to get out and see what's happening," she said.

Geoffrey hesitated a moment, then said, "Let me check my pendulum real quick first."

"Okay," she said as he headed for the basement. All seemed in order there. Maybe too much in order, for the pattern etched by the pendulum hadn't deviated a millimeter. He felt funny, leaving his project at the last moment, but it shouldn't matter. The camera would capture anything that happened.

Back upstairs, he donned his coat and hat and warned Eileen to not look directly at the Sun. The clouds had thinned enough to allow for some very anemic shadows.

Once outside, Eileen said, "Oh, look! Look at the funny way the fuzz on my mittens makes curved shadows!" She held her hands up and turned them from side to side, watching the unusual display, but Geoffrey gazed instead at Eileen's face. With a little curl of hair peeking out from under her stocking cap and a smile on her lips, he could see the college student in her, all alert and inquisitive. She was still the woman he fell in love with all those years ago.

They walked around their yard, pointing to the little oddities caused by the eclipse. Beneath the lacy ponderosa pine, Geoffrey pointed out the hundreds of tiny bright crescents on the snow. He explained that the needles of the pine acted the same way as a pinhole camera, projecting images on the shadowy ground. A feeling of twilight came over Geoffrey as the temperature started dropping. Indeed, the streetlights flickered to life. The birds at the feeder flocked together and flew into the neighbors' Douglas fir just as they did every evening.

Puffster, who was strictly an indoor cat after dark, meowed frantically at the back door. "He'll be okay," Geoffrey assured Eileen. "Totality won't last long and he'll want to come right back outside."

Puffster wasn't convinced. He scratched at the back door, then dug at the corner. Before Geoffrey could reach the door to make sure it was pulled tight, the cat had pushed it open.

He ran inside and down the stairs. Geoffrey didn't want to scare Puffster into really making a mess of the sand, so he tried to lure the cat back upstairs with soft promises of tuna. Puffster was having none of that, and ducked into the room with the pendulum. Cursing as he followed the cat, he rounded the corner and found Puffster . . . floating, levitating, whatever you wanted to call it, above the sand. The cat yowled in sur-

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prise and frantically scrabbled, trying to get a paw on something solid. Within a few seconds, though, the cat relaxed and purred loudly.

"Honey, you're missing it! We've reached totality!" Eileen said from the door.

Geoffrey stared at the unbelievable scene before him. He'd always joked that cats were somehow able to control gravity. Now he had proof!

"I'm not missing a thing," he called back.■

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The Writing Life **October 8 @ 9:00 P.M. EST**
Catherine Asaro, Kage Baker, and James Patrick Kelly on what it means to pursue the writing life.

October Chills **October 22 @ 9:00 P.M. EST**
Laurell K. Hamilton, the master of dark fantasy, talks about her work.

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BIOLOG Jay Kay Klein

KATHY OLTION

Kathy Oltion follows in the fingerstrokes of an early *Analog* writer, C.L. Moore. Like Cathy Moore, Kathy Oltion not only writes in her own right, but joins her husband in a symbiotic writing partnership. There have been several SF writer marriages, but to my knowledge only two pairs who said their styles were so alike that a collaborative story was seamless. Moore told me years ago that she or her husband Henry Kuttner could leave off typing for a break or nap, and the other would take over to continue.

Last time I mentioned C.L. Moore, a letter reached *Analog* accusing me of wrongly placing Cathy in this magazine. I had mentioned a great Moore character, not saying where published because *Weird Tales* means little to today's readers. It folded close to fifty years ago, not counting a recent revival. I still have the copies I bought so long ago. In the November, 1933 issue, I read Cathy's first story and was fascinated by Northwest Smith in "Shambleau." She created another sensation eleven months later with an SF love story in the October, 1934 *Astounding*. She graced these pages regularly for another twenty-five years. Kathy Oltion seems poised to follow by example.

Jerry Oltion was "biologed" in the April, 1985 issue. Since then, he's sold 100 stories, fourteen novels, including a recent Tor books hardcover *The Getaway Special*, plus a bewildering number of other writings. Kathy Oltion was raised in Rock Springs, Wyoming. She and Jerry met in a creative writing class at the University of Wyoming at Laramie.

They dated briefly before marrying. His goal was full-time writing, but graduating first he took a job to put Kathy through her last two years of school. After receiving her BS in medical technology, she got a hospital lab job in Cody, Wyoming so Jerry could try writing full-time. In six months, he sold his first story to *Analog*.

They now live in that hotbed of writers, Eugene, Oregon, where she does more challenging work at a medical lab that makes use of her strong background in medical microbiology and biochemistry. When Kathy finally left Wyoming for Eugene, she found the city's SF writers spurring her to write again. She resolutely gets in some aspect

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of writing every day, whether several pages of a story, a draft revision, or research.

She had written fiction from grade school through college, but stopped when she began working full-time up until joining a Eugene writers' workshop. The first *Star Wars* movie, seen eight times, hooked her on SF in 1977. She sold her first two stories as entries in a *Star Trek* contest in 1997 and again in 1998. Her first *Analog* story appeared in the September, 1998 issue. Jerry handed her a special "Really Good Story" award for it. Editor Stan Schmidt encouraged her to write stories about the medical lab, pointing out that few stories came to him about that topic. Stan's wife Joyce is also a medical technologist.

Kathy's first novel was written together with Jerry: *The Flaming Arrow*, "Book Four" of *Star Trek*'s *New Earth* series. Right now, she's sending out stories while working on two novels, one on her own and one with Jerry.

Starting with L. Ron Hubbard and Frank R. Paul, I've been asking SF writers and artists how they go about their work. Kathy gets her ideas in day-to-day living. The world is full of wonders and intriguing situations. She and Jerry do a lot of brainstorming about plots, characters, and other story elements. Jerry can complete a story in his head and write out as planned. Kathy can set up a story, but has to let it develop fresh over a hot keyboard. Writers are forever amazed at what their fingers set down on paper and how characters often run away with a story.

Kathy plans to write full-time. The beneficiary of Jerry's hard-won experiences, she sees she must treat writing as a real-world business. Editors, publishers, agents, production and distribution methods, markets, and readers' tastes are in a state of flux as rapidly changing as computer hardware. It's a tough way to make a living. But then, what isn't? ■

We can complain because rose bushes have thorns, or rejoice because thorn bushes have roses.

—Abraham Lincoln

Progress imposes not only new possibilities for the future, but new restrictions.

—Norbert Wiener

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QUARK STARS

A new type of star and a new kind of matter may have been discovered. Data on two unusual stars, RXJ1856 and 3C58, recorded by NASA's orbiting Chandra X-ray Observatory suggest that in the collapse of a massive star there may be a third alternative to forming a neutron star or a black hole. There might also be "quark stars" that are smaller and denser than neutron stars. In this column, I want to discuss these results and the possible role of quark matter in the collapse of a star.

Stars are fusion engines. In young stars, their energy and luminosity comes from fusing hydrogen into helium in the stellar core. After a time period that ranges from a few hundred thousand years for very massive stars to billions of years for small stars, the hydrogen-burning fusion phases out as the hydrogen is used up. Then the stellar evolution process reaches a branch point. If the star is less than a few times more massive than our Sun, its core shrinks and becomes hotter, while the outer regions expand, so that the star becomes a red giant. After a time, the red giant cools and shrinks to become a white dwarf star, and eventually a cold, nonluminous black dwarf.

However, more massive stars take a different path. The gravitational crunch of their core collapse creates enough temperature and pressure to produce helium-burning fusion, with three helium nuclei fusing to form carbon. This process continues with successively heavier elements—oxygen, neon, magnesium, silicon, and so on up to iron—participating in the fusion process, which synthesizes the medium-weight elements up to iron as the "ash" of helium burning.

Eventually the helium fuel is also consumed, and the star goes into another collapse phase, producing a spectacular explosion, a Type II supernova. The burned-out star still has a very large amount of gravitational energy. As soon as its nuclear-fusion power plant switches off, the gravitational energy is "cashed in" as the outer part of the star falls inward.

The star's mantle is no longer held in place by the heat and pressure of nuclear fusion. As it falls in, the density of matter in the interior grows progressively larger. Finally the density rises to about 10^{13} grams/cm^3, about three times the density of an atomic nucleus. For reference, a teaspoon of such super-dense matter would weigh as much as all the cars, trucks, and busses on Earth. At this density, unless the star is so massive that the collapse continues on to form a black hole, the in-falling material literally halts and bounces. The density has become so large that the "Pauli repulsion," the intrinsic repulsion of one neutron for another, one proton for another, or one electron for another, takes over and halts the collapse of the star.

Suddenly all the protons in the star's interior are able to gain energy by eating a nearby electron and spitting out a neutrino. In the process they become neutrons, and the inner part of the star be-

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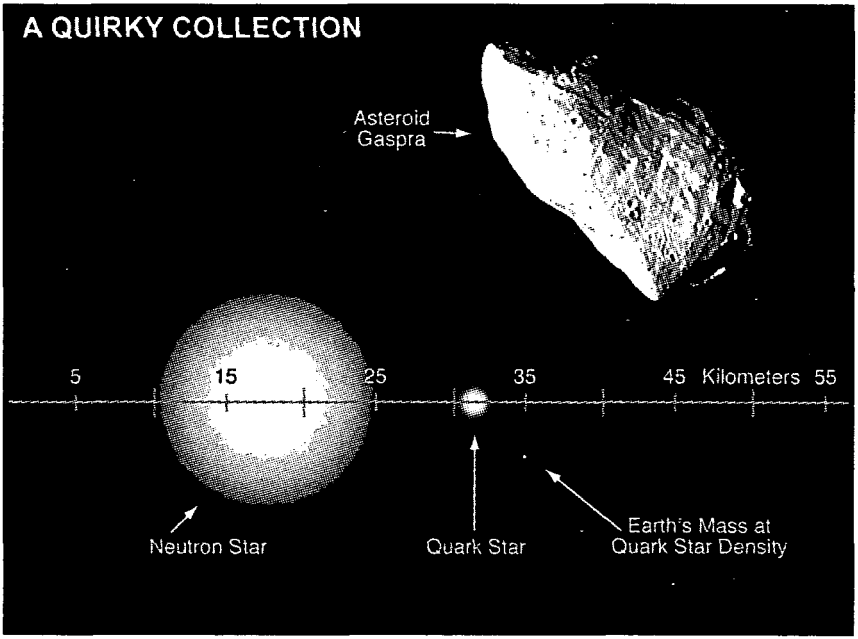

Illustration by Wolf Read

comes a neutron star. While this is going, on the outer part of the star is being blown outward by the recoil energy of the bounce. That outflow of energy and matter is boosted by the additional energy carried out to the shock wave by the flood of neutrinos from neutron star formation in the core.

About 100 times more energy from the supernova goes into the neutrinos than into the blast shock wave, and 100 times more energy goes into the shock wave than into visible light. Nevertheless, the visible light from the supernova can outshine the net light output of an entire galaxy.

When the outer part of the star lifts off, it leaves behind a cooling and rapidly spinning neutron star. The neutron star can be thought of as a gigantic spherical 15-kilometer-diameter nucleus. It has more mass than our Sun, is made almost entirely of neutrons, and is held together by the force of gravity. Its collapse has been halted by the mutual strong-force repulsion between neutrons, so that it hovers in a delicate balance between the pull of gravity and the push of the strong force. This balance would be overcome if the neutron star were more massive and had more gravitational attraction.

Radio astronomers first definitively observed neutron stars as pulsars, sources of periodic radio pulses that repeated a few hundred times a second. We now understand that these pulses are the result of a "lighthouse effect" of the radio beam emitted along the star's tilted magnetic axis, a beam that scans periodically in our direction as the star rotates, producing pulses. These pulses at intervals of a few milliseconds can also be seen in the visible light emission from neutron stars.

Neutron stars also produce X-rays, particularly when they pass through an interstellar region that has plenty of hydrogen that can fall in on the neutron star and produce million-degree temper-

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atures at its surface. NASA's Chandra X-ray Observatory, which was launched on July 23, 1999, is designed with a grazing-angle telescope mirror that can focus X-rays. It can pinpoint such regions of X-ray emission, produce images of extended X-ray objects, and measure the energy spectrum of their emissions. In the almost three years since its initial operation, Chandra has mapped the X-ray sky and performed detailed studies of many interesting X-ray objects.

Two of these objects seem to break the rules for neutron stars. Data from Chandra on a neutron star with the memorable name of RXJ1856.5-3754 (or RXJ1856 for short) shows a smooth X-ray spectrum and the lack of any significant pulsarlike activity in its time structure. From these data combined with observations from the Hubble Space Telescope, theoretical models suggest that the object radiates like a solid body with a temperature of 700,000 degrees Celsius and has a diameter of only 11±4 kilometers, significantly smaller than the diameter expected for a "normal" neutron star. Observations also indicate that probably RXJ1856 has recently moved into a relatively matter-free region from a dark molecular cloud, where it would have been reheated by in-falling matter.

Another neutron star, 3C58, has a rather different history, in that we know its birthday. Ancient Japanese and Chinese astronomers recorded its birth in a supernova explosion in 1181 AD. Chandra observations of the X-rays from 3C58 show that the star has cooled off much faster than would be expected for a normal neutron star.

Thus we have two puzzles: a star that is too small and a star that is too cool. The behavior of both of these unusual neutron stars can be explained with a single new assumption: that these stars have made the transition from dense neutron matter to an even denser "quark matter," in which there are no longer triplets of quarks forming neutrons, but is instead composed of quarks in direct contact with many other quarks. In this scenario, RXJ1856 may have started as a neutron star, but later, in its passage through the dark molecular cloud, it accumulated enough extra mass to make the transition to a quark star, with the neutrons dissolving under the intense force of gravity so that the star became a sphere of quarks. 3C58 would have an inner core of quark matter, but an outer shell, where the pressure is lower, that is still a neutron star.

What is the difference between a quark star and a neutron star? The standard model of elementary particles describes the neutron as a combination of two "down" quarks (quantum numbers: spin = 1/2, charge = -1/3, strangeness = 0) and one "up" quark (spin = 1/2, charge = +2/3, strangeness = 0), locked together by color forces and confined within a spherical "bag" with a radius of about 10^{-15} meters. The matter of a neutron star is a close-packed medium of such neutrons, each in its own bag, with the Pauli Exclusion Principle keeping them some distance apart.

The matter of a quark star, on the other hand, has no bags of quarks. Instead, equal numbers of up and down quarks, plus an equal number of "strange" quarks (spin = 1/2, charge = -1/3, strangeness = 1) are compressed together in the medium. The Pauli Exclusion Principle also keeps these quarks separated, but since there are three varieties with no bags, the packing is closer and the matter should be two or three times more dense. The strange quark in its "normal" state as a constituent of strange mesons and baryons is considerably more massive that the up and down quarks that form neutrons and protons. However, there are theoretical reasons to believe that at the energy densities present in a quark star the strange quark may become lighter. Even so, converting half of the down quarks in neutrons to strange quarks would require energy, and this may be the reason for the unexpectedly rapid cooling of 3C58. Thus,

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the small size of RXJ1856 and the rapid cooling of 3C58 are both expected consequences of the formation of quark matter.

Assuming this evidence stands the test of time, how common should quark stars be in our galaxy? The answer depends on some unknown factors, but there is a possibility that they may be fairly common. Even if few massive stars undergoing supernovas fall in the right mass range to go past the neutron star stage and halt at the quark star stage, many neutron stars either have companions that feed them extra material, or like RXJ1856, pass through regions of the galaxy with relatively large densities of dust and molecular material. Such neutron stars should grow in mass, and at some stage make the transition to the quark star state, as 3C58 appears to be doing.

Does the neutron-to-quark star transition make a new supernovalike explosion? The answer to this question requires modeling and is not settled at the moment. A major factor in supernova explosions is the bounce and outgoing shock wave arising from neutron star formation and neutrino emission. It is not clear whether quark star formation involves a major explosion or a quiet burp.

What is clear is that we need better theoretical models of this astrophysical process, more observations of quark star candidates, and more information on the behavior of the kind of quark-dominated matter that would be present in a quark star. Fortunately, the SPS accelerator at CERN and the new RHIC collider at Brookhaven National Laboratory are bringing heavy nuclei into high-energy, high-pressure, high-density collisions that should produce just this kind of matter in the laboratory. In the coming years, we should learn much more about quark matter and quark stars. ■

AV Columns On-line: Electronic reprints of over 100 "The Alternate View" columns by John G. Cramer, previously published in *Analog*, are available on-line at: http://www.npl.washington.edu/av.

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Special Feature

NIVEN'S LAWS, 2002

Larry Niven

"Niven's Laws" as of January 29, 2002

From time to time I publish this list; from time to time I update it. The most recent appearance, was in N-SPACE in 1989. In this version I took out laws that no longer look universal, and added a few insights.

To the best I've been able to tell in 2^6 years of observation, this is how the Universe works. I hope I didn't leave anything out.

1a) Never throw shit at an armed man.

1b) Never stand next to someone who is throwing shit at an armed man.

You wouldn't think anyone would need to be told this. It dates from the Democratic National Convention of 1968.

2) Never fire a laser at a mirror.

3) Mother Nature doesn't care if you're having fun.

You will not be stopped! There are things you can't do because you burn sugar with oxygen, or your bones aren't strong enough, or you're a mammal, or human. Funny chemicals may kill you slow or quick, or ruin your brain . . . or prolong your life. You can't fly like an eagle, nor yet like Daedalus, but you can fly. You're the only earthly life-form that can even begin to deal with jet lag. You can cheat. Nature doesn't care, but don't get caught.

4) Giving up freedom for security has begun to look naive.

Even to me. Many of you were ahead of me on this—Three out of four hijacked airplanes destroyed the World Trade Center and a piece of the Pentagon in 2001. How is it possible that those planes were taken using only five perps armed with knives? It was possible because all those hundreds of passengers had been carefully stripped of every possible weapon. We may want to reconsider this approach. It doesn't work in high schools either.

5) Psi and/or magical powers, if real, are nearly useless.

Over the lifetime of the human species we would otherwise have done something with them.

6) It is easier to destroy than to create.

Bin Laden tore down the World Trade Center? Let's see him build one. If human beings didn't have a strong preference for creation, nothing would get built, ever.

7) Any damn fool can predict the past.

Military men are notorious for this, and certain writers too.

8) History never repeats itself.

9) Ethics changes with technology.

10) Anarchy is the least stable of social structures. It falls apart at a touch.

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11) There is a time and a place for tact.
And there are times when tact is entirely misplaced.

12) The ways of being human are bounded but infinite.

13) When your life starts to look like a soap opera, it's time to change the channel.

14) The only universal message in science fiction: **There exist minds that think as well as you do, but differently.**
Niven's corollary: **The gene-tampered turkey you're talking to isn't necessarily one of them.**

15) Fuzzy Pink's Law: **Never waste calories.**
Potato chips, candy, whipped cream, or a hot fudge sundae may involve you, your dietician, your wardrobe, and other factors. But FP's Law implies: *Don't eat soggy potato chips, or cheap candy, or fake whipped cream, or an inferior hot fudge sundae.*

16) There is no cause so right that one cannot find a fool following it.
To prove a point, one may seek out a foolish Socialist, thirteenth century Liberal, Scientologist, High Frontier advocate, Mensa member, science fiction fan, Jim Bakker acolyte, Christian, witch, or fanatical devotee of Special Interest Lib. It doesn't really reflect on the cause itself. Ad hominem argument saves time, but it's still a fallacy.

17) No technique works if it isn't used.
If that sounds simplistic, look at some specifics: Telling friends about your diet won't make you thin. Buying a diet cookbook won't either. Even reading the recipes doesn't help. Knowing about Alcoholics Anonymous, looking up the phone number, or even jotting it down won't make you sober. Buying weights doesn't get you muscles. Signing a piece of paper doesn't cause a cease-fire, even if you make lots of copies and tell every anchorperson on Earth. Endlessly studying designs for spacecraft won't put anything in orbit.

18) Not responsible for advice not taken.

19) Think before you make the coward's choice. **Old age is not for sissies.**

20) Never let a waiter escape.
What I'm urging on you here is manners: don't ignore the poor bastard while you hold him prisoner. Remember, he can do that to you later by withholding the bill.

Niven's Laws for Writers

1) Writers who write for other writers should write letters.

2) Never be embarrassed or ashamed by anything you choose to write.
(Think of this before you send it to a market.)

3) The story to end all stories on a given topic, doesn't.

4) It is a sin to waste the reader's time.

5) If you've nothing to say, say it any way you like.
Stylistic innovations, contorted story lines or none, exotic or genderless pronouns, internal inconsistencies: feel free. **If you need to say something important or difficult to follow, use simple, direct language.** If the reader doesn't get it then, let it not be your fault.

6) Everybody talks first draft.■

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By the Lake

Jeff Hecht

"How do you keep your little lake so peaceful and quiet, Rachel?" Jennifer asked, as the younger woman opened a bottle of California red wine. The vintage was drinkable, but nothing Jennifer would serve to guests.

"It's taken a lot of work over the last few years," Rachel replied, setting the bottle on a tray with two wine glasses, brie, and crackers. "Nothing like setting up the company, of course, but it does have a connection. We stock it with our own fish."

"I hadn't realized that." Jennifer's investment firm had taken Aquatic Genosynthesis public, and she thought she knew all the company's major projects.

"It's under research and development on the balance sheet," Rachel said, sliding open a wide glass door and leading the way onto the deck.

"It sounds like a nice little tax dodge," Jennifer said. She had to keep alert for CEOs siphoning too much cash out of their companies; it might depress the stock value.

"No, it's one of Ron's projects. He thinks recreational fishing could become quite a large market. He's working quite hard on it; he takes his father out on the lake almost every weekend to evaluate the results, like he took your husband."

That had amused Jennifer. Her husband was an accountant, and after her twenty-five years in investment banking he normally didn't set foot on anything smaller than a yacht. "Do you think Ron can help him catch something? The poor dear hasn't been fishing since his eighth birthday." She could see their boat near the shore, moving slowly, although she couldn't hear a sound from its little engine.

Rachel set the tray down on a glass-topped table between two chairs. "I'm sure Ron can help him, but Ron's father was really the one who had the idea. Ron's dad was a biologist at the state fish hatchery for forty years before he retired

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last year. He knows an amazing amount about the feeding instincts of various fish, and what sort of lures can attract what sort of fish."

Jennifer settled into a lounge chair. "What does that have to do with genetically modified fish?"

"Ron's dad thought the feeding cues were genetically controlled, so when Ron was at the university, he had his grad students look for genes that control what the fish respond to. They found several genes for specific responses, like striking at something that moved in a certain way, or generated specific noises."

Jennifer got the idea. "Is that how the fish recognizes its dinner?"

"Exactly. For fish farming, we engineer in fast growth and limit breeding outside of the environment we control, to protect our investment. For recreational fishing, we modify other genes to modify feeding response."

"How does that make them more attractive for fishing?"

"Ron designed an artificial lure—a kind of high-tech fly—that creates a pattern the fish are programmed to strike at. We've tested it and the fish go for it every time. At the company, we were able to step up their growth rate, and our latest trick is to adjust this behavior so the fish don't start striking at the lures until they are large enough to impress the fishermen. We stocked them in this lake last year, and they're already big enough to start striking. A few of the old-time purists don't like it, but it attracts the casual fisherman."

"And how big a market is this?" Jennifer asked. A big market could justify a secondary offering, which could earn her a fat commission.

"Billions," replied Rachel, then paused and looked onto the water, evidently distracted.

Jennifer's eyes followed and saw a wake far down the lake. Her ears picked up the whine of a jet ski motor.

"Damned moron!" Rachel said. "We had the public boat ramp blocked, but they still manage to get in."

"The noise is annoying," Jennifer said, glad to see that Rachel's lake wasn't perfect. "Our lake association keeps lobbying our state legislators to ban jet skis, but they want more campaign contributions before they introduce a bill."

"This isn't just an aesthetic issue, Jennifer. The wakes damage the delicate shore ecology, and the noise chases off birds and frogs, and upsets the fish."

"Can you use your genetic technology to make the fish less sensitive, so it wouldn't bother them?"

"I suppose that's possible, but we're going in a different direction." Rachel picked up a pair of Zeiss binoculars from the table to look more closely at the water. "We have a new experiment with pike, and if it works, you might see something in a minute."

"Why pike?" Jennifer knew only the fish that came on plates.

"They are voracious predators. We've speeded up their growth rate, and now are fine-tuning their instinctive striking response to just the right noise level. Watch over there," she said, pointing.

The jet ski sped uncomfortably close to a small child on a raft as it changed course, turning back up the lake. Jennifer followed Rachel's gesture and saw a dark shape moving from the middle of the lake. Suddenly it broke the surface and a huge mouth gaped open in front of the jet ski. There was a huge splash, with water spraying in all directions and blocking their view. Then the giant mouth, the jet ski, and the kid riding it were gone. Waves spread silently outward from the spot.

"The response threshold is perfect. That should show the bastards," Rachel said, putting down her binoculars.

Jennifer picked her glass of wine from the table and sipped. It was a much better vintage than she had realized. She had underestimated Rachel. "I can see a very big market. I'm sure our lake association will be interested."■

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The Human Equations

Dave Creek

People confronted with new dangers must try new responses—but along that path, too, lie still newer dangers.

As many times as I'd been called upon to banish Volatile people to Earth, few of them had ever attacked me. The final time it happened was within the New Lancaster Habitat, home to 10,000 New Order Mennonites, known as the "Habitat of the Gentle People." Moments after I arrived at the farm of Bishop Anna Troyer and her son, Samuel, I knew it contained at least one exception.

As I stepped onto the porch, I couldn't help thinking that the Troyer home looked like something out of history: wooden structure, metal gutters, the porch sporting a swing and rocking chairs. An even more primitive-looking building, the barn, stood in the rear. Between them was an electric car, and a larger vehicle that probably harvested the crops. In fields both adjacent to the Troyer home and directly overhead, I could see people working in the sprawling fields scattered throughout the habitat.

The heat and humidity of the habitat's interior washed over me. It was only midmorning and already conditions here were oppressive; why would people work in those fields all day? I wished I could've come about a week later when the habitat was due to turn colder. It was a practical measure; the apple, cherry, and pear trees needed that cold snap to blossom.

I knocked on the flimsy-looking door, which was a thin frame of wood surrounding a fine metal mesh. Out of the shadows within the house, two figures resolved themselves. Bishop Troyer was dressed in a gray one-piece dress beneath an apron of the same color, and wore her snow-white hair up, topped with a finely pleated white hat. I knew she was only middle-aged, about sixty, but her deeply lined face made her look decades older. Being a Mennonite, I thought, must be a rough life. I knew it could even be deadly. Bishop Troyer's husband Amos had died eight years earlier when a grain harvester rolled over

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on him—not an uncommon fate for farmers here, apparently.

Samuel was twenty, broad-shouldered, and with skin burnished by countless hours beneath reflected sunlight. He was wearing a farmer's overalls and thick-soled boots.

Bishop Troyer didn't speak, just glared at me, but she still opened the door—Congregationalist courtesy, no doubt. I stepped inside, grateful for the respite from the heat. "I'm Triage Officer Leo Bakri. I'm here to carry out the Order of Banishment on Samuel Troyer."

The only thing that saved me was that although Samuel was big, he wasn't a trained fighter, and that my New Human reflexes are faster than those of most Volatiles. His right fist swung at my face, and I grabbed it with my right hand and twisted sharply, measuring my force so I wouldn't break his wrist. Samuel yelped and sank to one knee. I placed my hand on the butt of my stunner but didn't draw it.

Bishop Troyer went to her son's side and held his shoulders. I wondered if she was trying to comfort or restrain her son.

I felt the chill of perspiration drying on my forehead. The house wasn't climate-controlled, but it was cooler than the habitat's current outdoor setting. Too much like a "natural" environment, too uncontrolled, I thought. Why should any environment be uncomfortable for the Humans living in it?

Bishop Troyer said, "You realize that sending Samuel down there is a certain death sentence?"

I said, "You know the seriousness of Samuel's crime."

"I still have trouble believing that Samuel would—"

"Attack someone the way he just attacked me?"

Samuel looked up at me. "You're taking me away from my mom, you bastard!"

"Samuel!" Bishop Troyer said. "Even in such a time, you'll not use that kind of language."

"Mom, he's taking my life away."

I said, "Samuel, you know the law. There are no appeals."

Bishop Troyer said, "Triage Officer Bakri, you must understand my son doesn't want to leave his home."

In my heart of hearts, I didn't think his home was anything to fight for. The many shelves and a mantle above the fireplace (now *there* was a danger!) here in the living room were crowded with, I believed the term was, "knick-knacks." They included small stylized figurines with vaguely Human form, tiny woven baskets of an unknown (at least to me) significance, and flat, unmoving pictures of loved ones. The paintings on the walls seemed to be originals by talented but untrained artists. The comp in one corner was a bulky console-and-monitor combination.

Samuel Troyer said, "You didn't prove anything—"

I told him, "We have cubes. They show you inside a shop within the Shosha Habitat, assaulting its manager, Saburo Endo."

Bishop Troyer stood. She held her hand out to Samuel, who took his place beside her and said, "That's not evidence to us. My people don't use that kind of technology."

"With all respect to your beliefs, the Shosha authorities *do* make decisions based upon that technology. We also have nearly a half-dozen witnesses to the assault against Mr. Endo. You know the penalty for traveling to another habitat to commit violence."

Samuel Troyer tilted his head and squeezed his eyes shut. "I didn't *go* there to commit violence." Then he looked me right in the eye. "I just wanted to see what it was like somewhere you don't have to get up in the middle of the night to milk cows. Or spend half your days just growing food. Where you have time to read and to think—"

Bishop Troyer shook her head. "It looks as if you've spent too much time

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thinking already, and it's allowed ungodly ideas to get into your head. I never should've agreed to that trip. You're too young. You don't understand why our way of life is so important to us."

Samuel's voice held a bitterness I guessed he'd been nurturing for some time. "You always said these places were so evil. I wanted to decide for myself. I always expected to come back here. And I did. I wanted to find a way to make a different kind of life for myself *here*, with you."

I said, "You knew you were here only on probation, awaiting your sentence."

"On something that wasn't a crime. I just wanted something nice for my mother."

"A gold necklace worth six months pay on Shosha."

Bishop Troyer said, "My son had never been to another habitat. He had no concept of a market economy."

"You should have taught him, then. To let a Volatile—"

"I am so sick of hearing Samuel referred to by that term. I suppose you're what they call a New Human?"

"I am." I allowed a little pride to come through in my tone of voice. Nothing wrong with faster reflexes, added strength, or more immunity to disease. Not to mention the moral improvements. Less prone to violence. More inclined to find peaceful solutions. "I'm from Newton Habitat." Customarily, Banishment Orders were carried out by Triage Officers from habitats other than those involved in the original crime. The Earth-circling habitats have two common rules—live as you wish, but anyone can leave whenever they want. And anyone who commits the slightest physical assault is immediately banished.

Samuel shook his head. "Great. Not just a New Human, but a scientist. You think you're better than I am."

I shifted my weight from one foot to another. No one seemed likely to offer me a seat. And I wasn't sure I'd accept it—the Troyers' living room chairs were wooden, some upholstered with actual cloth, everything apparently handcrafted. I supposed that was fine if you liked that kind of thing, but it all seemed unnatural and wasteful of time and resources to me. "Statistics show a Volatile is more likely to act inappropriately. A point you helped prove on Shosha."

Samuel wiggled his fingers in front of my face. "They were *so* upset that these hands touched their precious property."

"In Shosha, it's called stealing."

"And the shopkeeper—"

"—Mr. Endo—"

"—was rude. He yelled at me in front of all those people in the market square. And he grabbed my arm so hard it hurt."

"You wouldn't let go of the necklace."

Samuel shook his head. "It was mine. I'd picked it up. I tried to tell them I'd send them something in trade later."

"That's when the real crime happened. When you struck Mr. Endo."

"He wouldn't let go of my arm. He started it."

I said, "And I'm finishing it. Get your things."

Samuel pointed to one of the upholstered chairs. "There's my bag." His shoulders slumped, as if having prepared the bag also meant acknowledging his crime. He picked the bag up and stood passively, his attention focused on his mother.

I told him, "You can see that I'm accustomed to dealing with Volatiles. If you try to assault me or anyone else again, I'm stunning you and carrying you to the port. If you give me your word you won't be violent, I'll let your mother come along."

Bishop Troyer folded her hands in front of her. "Thank you, Triage Officer." She looked meaningfully at her son. "We may be plain unaltered Humans, but we won't be any trouble."

I said, "My car's waiting."

I insisted that both Bishop Troyer and Samuel ride in the rear of my borrowed police cruiser. The car mostly drove it-

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self, which let me keep an eye on them on a heads-up vid display.

As we drove off her property, Bishop Troyer said, "All this for a trinket I wouldn't have wanted anyway."

Samuel said, "The gold was from what you call the good Earth. I know you miss it there, even if you never want to go back. The shopkeeper said it was handcrafted, not replicated."

I said, "They just say that, Samuel. That's a typical ploy to get a little extra money out of a tourist."

Samuel's mouth gaped open. "He'd lie?"

"Plenty of shopkeepers in plenty of habitats will do the same thing."

Bishop Troyer said, "It's one reason we chose a different path in this place."

New Lancaster Habitat was a typical kilometer-long cylinder, its homes mostly single-family dwellings scattered across a broad landscape of furrowed fields. Most Human colonists brought workbots, nanotech, and grav pallets, along with virtualities and newsnets. They desired the conveniences of Earthly existence even while they sought more living space or the opportunity to form a unique societal structure.

Not here. Workers harvested timothy and clover in the countless fields that curved upward and met two-tenths of a kilometer overhead. I didn't understand the pull of such an existence. The repetitive toil, the eternal cycle of artificially-generated seasons with the rituals of planting and harvesting, and all for what?

I supposed that was why we have dozens of habitats circling the homeworld. Live as you want, without anyone abridging your freedoms.

But that was just what Samuel Troyer had tried to do to Mr. Endo in Shosha.

I said, "If Samuel had struck someone here in New Lancaster, it would've been a purely internal matter. But it's gone interhabitat. It's the equivalent of a diplomatic incident on Earth."

Samuel sat with his hands in his lap, as if waiting for his mother and me to settle this between ourselves. I had to wonder if the anger he'd shown just moments ago had been only momentarily suppressed.

Bishop Troyer asked, "Can't you give Samuel some leniency? He's never been in trouble before."

"Could I suggest you render unto Caesar that which is—"

"That is an inappropriate context for that reference, Triage Officer. And you will *not* use my religious beliefs as a pretext for taking my son from me."

I took a deep breath. "I apologize."

Samuel rolled his eyes at that, which I pointed out to Bishop Troyer. "You see his attitude? Haven't you glimpsed that before?"

Bishop Troyer cast a hard look at her son. "Only . . . aimed at me."

"With all respect," I said, "Perhaps Samuel found it all too easy in Shosha, a place where no one knew him, that he could intimidate anyone who challenged him as he committed his mischief. Add to that, not realizing his actions were being recorded in holographic vid and immersion sound."

Samuel said, "Perhaps you *should* take me away. I might finally find respect down there on Earth."

Bishop Troyer said, "Don't even pretend to feel that way. I'm still your mother, I'll always care for you the way no one else can."

I said, "You can still care about your son, Bishop Troyer. He just can't continue to live here."

Bishop Troyer turned a stern visage toward the vid input. "We're talking about a twenty-year-old boy who committed an inadvertent theft, and who struck a shopkeeper. Meanwhile, we don't seem concerned that we're about to send Samuel down to a planet where some countries still mandate the death penalty for nonviolent crimes. The PacFed doesn't believe you have a soul, Triage Officer, or even that Samuel or I do, and it wouldn't be illegal to kill us

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for no reason. The Eastern Sword chops the hands off of thieves. Do you need more examples?"

I said, "A condition of establishing Human habitats in Earth orbit was that we could only ship back malcontents or criminals if a government agreed to take responsibility for them. That makes it difficult for us, but if Samuel doesn't go to Earth, that would mean someone who committed violence wouldn't be dealt with. Our entire system will fall apart, in every habitat. Samuel *will* leave. But he goes somewhere he's wanted."

"What kind of place will have me? What kind of people can I live near?"

I said, "Most of the world falls into two major categories, culturally."

Samuel frowned. "Yes, Euro-American and Afro-Asian. I've been to college, thank you."

"Your culture here most closely resembles Euro-American. I've gotten you a good job on the English Strait. Reclamation duty. They're desperate for manpower there."

Samuel asked, "Manpower? What's that?"

"People who perform physical labor, or sometimes skilled tasks."

"Why would anyone perform physical labor back on Earth?"

"Some societies there also reject nanotech, just as your own does."

"What if I refused to work? What could they do to me?"

"You wouldn't get paid. You wouldn't be able to buy food or clothes or shelter."

"Oh, I see, these are places like Shosha."

"Much worse than Shosha. Hard work, very little pay. Hard to get ahead. Harder still to save for old age."

"They don't even take care of old people?"

"You have to save enough so you can get by when you're too old to work."

We'd arrived at the habitat's southern cap. I flashed my Triage Services shield at the nearest lift, asking the civilians gathered there to take the next one. I didn't think Samuel would become violent again, but I wanted to keep things simple.

Aboard the lift, we all grabbed handrails as the habitat's floor, and the pseudo-gravity of its rotation, fell away. Looking across the one-kilometer distance to the northern cap, I saw people who had donned wings and were flying along the cylinder's center. "That surprises me," I muttered, and when Samuel tilted his head in a questioning look I pointed out the fliers.

"It's simple tech," Samuel said. "As natural as the flight of birds."

Then it was off the lift, in zero-G conditions now, and into the passenger waiting area. Both Bishop Troyer and Samuel glided awkwardly through the broad tube that led from the revolving cylinder of New Lancaster to its stationary hub. I'd made sure we arrived only minutes before departure; I didn't want to draw this out. I'd only allowed Bishop Troyer to come along because I thought her presence would help me deal with Samuel until I got him aboard the shuttle.

We reached the broad waiting area. About three dozen other passengers were also waiting to board the shuttle down to Earth. I'm sure my sigh of relief was audible. Gone were the organic smells and too-warm, too-moist air that had assaulted me when I first entered New Lancaster proper. I marveled at the small comforts I found in filtered air, smooth white surfaces, and decorative cube images of planets and galaxies that were the same in any such chamber.

Another flash of the shield, this time toward a customs officer. He said, "Don't worry, Triage Officer, we'll get you seated first, in just a moment.

As we all moved to one side and grabbed handrails, I sneaked a glance at Bishop Troyer. Her mouth had tightened into a narrow line that emphasized the wrinkles in her face. I'd seen similar ex-

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pressions before, on dozens of frustrated parents' faces—she was coming to grips with the reality that she was about to lose Samuel. She couldn't prevent me physically from taking him, and they'd had no legal options or I wouldn't have arrived at their doorstep. "I know this is difficult," I said, "But look at the broader view—"

Bishop Troyer said, "I don't have a broader view. I only know I'm losing my son."

Samuel was grinning. "Let him spin his fairy tales, Mom."

Bishop Troyer's lips pursed and she looked at me. "Have your say."

"Human history, from the nineteenth century onward. Conflicts between empires gave way to the superpowers, whose disputes dominated the twentieth century. Some of those disputes involved intermediaries, often on the Asian continent. But after two global conflicts, wars became localized or internal. The world's countries *were* learning to live in peace. But in the very first year of this century, Humanity saw war waged by individuals."

Bishop Troyer lowered her gaze. "We're a sinful race."

"This is where it started. With a simple assault, and the most basic disrespect for another person."

Bishop Troyer said, "You spout your theories of history and how Human society evolves as if they're as certain as the laws of physics you worship."

I said, "That's a good analogy. The laws of physics have been called the 'cold equations.' My job is to make sure legal consequences approach that same certainty."

"Then you, Mr. Bakri, are even colder than the laws of physics. Perhaps you embody the human equations. And if I refuse to let Samuel go?"

"I can take *you* into custody, too."

Samuel said to me, "I'll go to Earth."

Bishop Troyer said, "Samuel, no!"

"Mom, what kind of choice do I have? I'm young, I can adapt."

Like you adapted on Shosha? I thought, but wasn't about to say aloud.

Bishop Troyer asked her son, "Do you know the dangers you'll face there?"

Samuel said, "Radiation. Marauders. Leftover nanoweapons."

"We have to find you something somewhere else."

I said, "Most countries aren't interested in taking a Volatile. They don't want our—"

"Castoffs? Rejects?"

"I believe you're both good people. It's just that Samuel did something that can't be tolerated in this community."

Bishop Troyer offered me a sad smile. "I have my own beliefs about what can be tolerated and what cannot. As does everyone who has received our undeserved gift—God's love. We reciprocated that gift by building a community filled with Christ's attributes. Forgiveness is one of those attributes."

I didn't have anything to say to that.

"Don't worry," Bishop Troyer said. "I'm not a proselytizer. I'm willing to speak in the limited terms of everyday life. Did it ever occur to you that maybe Samuel thought he was in the right?"

"You've seen the vid?"

"I have. I don't approve of what he did, but I don't believe it's worth banishment."

Both of Samuel's eyebrows raised and his jaw dropped open. "How did you see it?"

"The farm's comp. It has HabNet access."

"But you never allowed me to—"

"To fritter away your time on foolishness—games and useless knowledge disguised as revealed truths or wisdom? No, I never did. But this is different. I had to see for myself what happened."

I kept quiet. I thought letting this little drama play out might be the best thing for me.

Samuel said, "You had no right—"

"I have *every* right to know about my son's actions. It was foolish to let you go there. I can only ask the Lord's forgive-

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ness. If only your father had lived—"

Samuel wagged his finger before his mother's face. "It always comes back to that, doesn't it? The sacred Amos Troyer, who could do no wrong—"

Bishop Troyer knocked Samuel's hand aside, and by his reaction, you would've thought she'd slapped him full in the face. "You will respect your father."

Samuel recovered quickly, and his features hardened into an expression that belied his youth. "I've always respected my father. It's your attitude toward him that wears me down."

Bishop Troyer extended her hand toward Samuel's face. He flinched, then seemed to realize his mother's touch would be gentle this time. Anna Troyer caressed her son's face. "I'll always love you despite how you treat me."

Samuel said, "I know, Mom. It's just . . . I have to make my own decisions now."

The customs officer caught my eye and waved me toward the embarcation sleeve. I told Bishop Troyer, "I have to accompany Samuel down to the surface."

Bishop Troyer told me, "My son didn't understand."

"We don't care whether he understood. We care only that he not repeat his actions, whether in Shosha or here in New Lancaster."

"He wouldn't have. I'd have made sure of it."

"He's a Volatile. We couldn't be sure. Now we will be."

Mother and son embraced, held on tight, cried. I started to touch Bishop Troyer on her shoulder but couldn't bring myself to. I coughed softly. The Troyers took the hint and said their final goodbyes. Bishop Troyer told me, "I'll pray for him. And for you, and those who create our laws."

I thought it only appropriate to say, "Thank you." Then Samuel and I left.

I didn't dare look back at the grieving mother.

Samuel sat next to me quietly during the entire half-hour trip. I wondered how many of the other passengers might also be Volatiles, though I didn't recognize any Triage Officers from other habitats.

We'd be landing in the desert linking the sloping plain that was once England's Shakespeare Cliff to the ruins of the French village of Sangatte. It was only during the shuttle's final approach that Samuel said, "Tell my mother everything will be all right. Even if it won't."

This Volatile's concern for his mother tore at my heart in a way I hadn't anticipated. I could almost forgive Samuel for attacking me back in the New Lancaster Habitat.

Almost. I didn't respond to his request, and Samuel didn't make it again.

The shuttle settled to the barren ground and Samuel and I followed the other passengers, about six or seven, who were getting off.

Bright light and blowing dust made me squeeze my eyes to slits as I followed Samuel out of the shuttle and stepped onto dusty ground. Close to the horizon, I saw the reclamation facility that fought the losing battle to reclaim this strait as fertile ground. Nanotech conflicts had left the land full of unwanted surprises, from transformation mines to deathtech. The suggestion had already been made in some quarters to let it return to its "natural" state, to become the English Channel again. As if natural meant static, unchanging, safe.

A tall man in a crisp uniform and wearing a breathing mask walked up to us and introduced himself as StraitForce Lieutenant Phillipe Cassell. "I'll take the boy now," Cassell said, his voice stern and metallic through the mask.

"Where's *my* mask?" Samuel demanded.

"You'll get one when you earn one," Cassell said. He pulled Samuel toward a waiting personnel carrier. Samuel looked back at me and said, "Goodbye." My mouth was dry and I choked back words. By the time I raised my hand to

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wave, it was to Samuel's retreating back.

That's when a sharp *crack* came from overhead and I was knocked to the ground. I lifted my head from the dust just in time to see the rear of the personnel carrier blasted away. Armed men and women were popping up from beneath the ground. They were aiming weapons and squeezing triggers, but I didn't hear discharges and didn't see flashes of light.

I got up and ran toward Samuel Troyer and Lieutenant Cassell, who were lying next to the carrier's wreckage. I pulled my stunner and got off a few shots, without hitting anyone.

Samuel pulled me down next to him, clearly glad to see a familiar face, even mine. He seemed unhurt; Cassell's chest and face were ruins. Before we could say anything to each other, Samuel slumped to the ground. Whether unconscious or dead, I didn't know.

A scuffling sound to my right, and I raised my weapon at a gunner advancing toward me.

Some New Human I was. The gunner was quicker and even though I still didn't hear a discharge or see a flash I slumped to the ground next to Samuel.

I found out what happened when I woke up in the reclamation facility's hospital. A Channel Separatist raid on the reclamation facility had ended with nine raiders dead, but fifty-two workers killed and 142 others, including Samuel, suffering nanoinfestation.

The Separatists had sprayed destructive nanotech over much of the facility. I was lucky; being a New Human gave me some resistance to such intruders, and my status as a Triage Officer meant I was one of the first attended to. Yes, I'm aware of the irony. The doctors flushed out my system successfully, and I was out of the hospital within hours.

Samuel, though, wasn't so lucky. The tiny disassemblers roamed through his bloodstream and throughout his nervous system, altering his body with an excruciating slowness.

I went to see him every few hours over a period of three days after the attack. Samuel's body was literally turning to dust. His feet crumbled away within hours of the infestation, and his legs were gone in a day. The nanotech made sure Samuel's skin closed around the parts of his body that remained, but did nothing to relieve his pain. "I'm bearing it," he told me through gritted teeth, "because I want to live." Once when I found him sobbing uncontrollably, he said, "I'm not crying for myself. It's my mother. I have to get better. I don't want her to know I'm suffering."

Doctors pumped him full of reconstruction nanotech and implanted temporary artificial organs as his intestines, liver, kidneys, heart, lungs, and other organs failed, then became dust.

Sixty-nine hours into his agony, doctors had given up on saving Samuel and were issuing frantic petitions to London and Paris for permission to euthanize him. The reply never came. He was, after all, only a Volatile.

The separatist attack told me no one was safe, and that it didn't matter who you were. Lieutenant Cassell had only been doing his duty. Samuel Troyer was a mixed-up young man who hadn't done anything that deserved a death sentence—something I'd realized in the final moments of Samuel's life.

All that remained of him was a head and an upper torso. He was breathing through artificial lungs and could still manage halting speech. Moments before he died, Samuel said he felt a comforting presence nearby, someone other than myself or the doctors. I knew he was a spiritual man, and I was glad that he'd received this vision in his final moments. But then Samuel's demeanor changed. His face contorted, and not from pain; his nerves couldn't transmit pain anymore. He forced one word out before he died: "Abandoned."

I couldn't speculate on what it was Samuel saw or heard, or who had aban-

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doned him, though I had my own ideas.

Within a day of Samuel's death I was standing on Bishop Troyer's porch on another sweltering morning, knocking on her door again. I considered it a mercy that she hadn't been allowed down to the Strait to see her son, because of the continuing separatist danger. I peered through the door's wire mesh, and saw a long wooden table set up in the living room, with plates and casserole dishes full of food spread across it.

The door opened halfway, and Bishop Troyer stood there, dressed in a white dress with a white cape. I'd expected her to look withered and worn, but she stood upright and sturdy. I wondered how long her newfound energy would last once the other mourners were gone. I wondered how long she might live.

The soft background conversations filtering through the doorway stopped one by one as guests noticed my presence.

"I know I'm probably not welcome here," I said.

Bishop Troyer's eyes seemed to perceive every wrong I'd ever perpetuated in my life, every broken promise, every petty insult. Every time I thought of myself as morally superior to a Volatile, because I was a New Human.

Never mind taking her only child to his undeserved death.

"Of course you're welcome here, Triage Officer."

"I'm not a Triage Officer any longer." At Bishop Troyer's questioning look, I said, "I've resigned. I won't be banishing any more Vol . . . any more citizens."

Bishop Troyer opened the door further. "Enter in the spirit of forgiveness."

I stepped inside, aware of all the eyes upon me. Mourners, most of whom would have known Samuel Troyer at his best as well as his worst. Bishop Troyer and I moved into one corner of the room and spoke quietly as other conversations rose again.

I told her, "I realized being a Triage Officer had only been my way of dealing with my own fears. I told myself others were responsible for them. Eliminate those others from my life, and I'd be secure. The fact that I operated with the habitats' laws on my side was only an excuse."

"And your new job?"

"Within a month, I'll be joining the Earth Alliance exploratory craft *Laika* as chief security officer."

"Are you so eager to explore? Or are you leaving your past behind?"

"I don't think I'll know for awhile."

Bishop Troyer looked thoughtful, not as haunted. "Then my son's death served some small purpose. Tell me how he died."

I hesitated, and Bishop Troyer said, "I'm sure he asked you to spare me the details. He always wanted to protect me."

I felt the corners of my mouth turn up just a little. "It was all he said to me on the way down to Earth. Tell you everything was all right, even if it wasn't."

"And as he was dying?"

"He didn't want you to know he was suffering."

"His suffering has ended, and he's with the Lord. You know you failed him."

I lowered my head. "Yes, I do."

I started at the touch of Bishop Troyer's fingers beneath my chin. "Then you mustn't fail me. I want to believe that the more he suffered, the more heroic he became."

"He did."

"Then don't give me the peaceful, sanitized version of his death."

So I told her, and she listened and didn't say anything, but her eyes closed tightly halfway through my description of Samuel's suffering and death. By the time I'd finished my tale she had one hand over her eyes and her chin was quivering. When she started to sob, her hand moved to cover her mouth, and she turned her back toward the friends

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and relatives who'd come to grieve with her.

Eventually Bishop Troyer composed herself. "I can't provide your forgiveness, Leo Bakri, and you won't find it out among the stars. It'll only be within your own heart. A lesson I've learned." Her mouth quivered, and she raised her hand to it again. I could hear her muffled voice. "Oh, Samuel, why was I so foolish?" Anna Troyer looked at me. "He promised he'd be a better, more respectful son. Just let him do this one thing, he said. It's all I'd ever wanted. That's why I let him go. Because of what I wanted."

She turned away from me then, and joined the other mourners. As I was leaving I paused in the doorway, aware that Bishop Troyer and I were embarking on a shared journey.■

IN TIMES TO COME

Michael Swanwick, a relative newcomer to *Analog* despite his considerable and well-earned reputation elsewhere, moves to the cover slot in our December issue with "Slow Life." Despite its name, it's a fast-paced and gripping adventure story as well as a highly thought-provoking tale of very alien contact. The decidedly exotic (though not particularly distant) world Swanwick portrays needed just the right hand to bring it to life visually, and I think you'll agree that that hand belongs to David A. Hardy.

Wil McCarthy offers another decidedly exotic world in "Garbage Day." This one is exotic not by nature but by design: it uses, for practically everything, the "programmable matter" McCarthy talked about in a recent fact article—and that makes for a very strange environment indeed!

The rest of the fiction line-up has a stellar composition, including stories by Stephen Baxter, Stephen L. Burns, Jerry Oltion, and something a bit seasonal from Charles L Harness. And Ben Bova returns with a science fact article on "The New Outlook for Astrobiology," which involves not only a confluence of several sciences, but a goodly dose of politics in the glue that binds them together.

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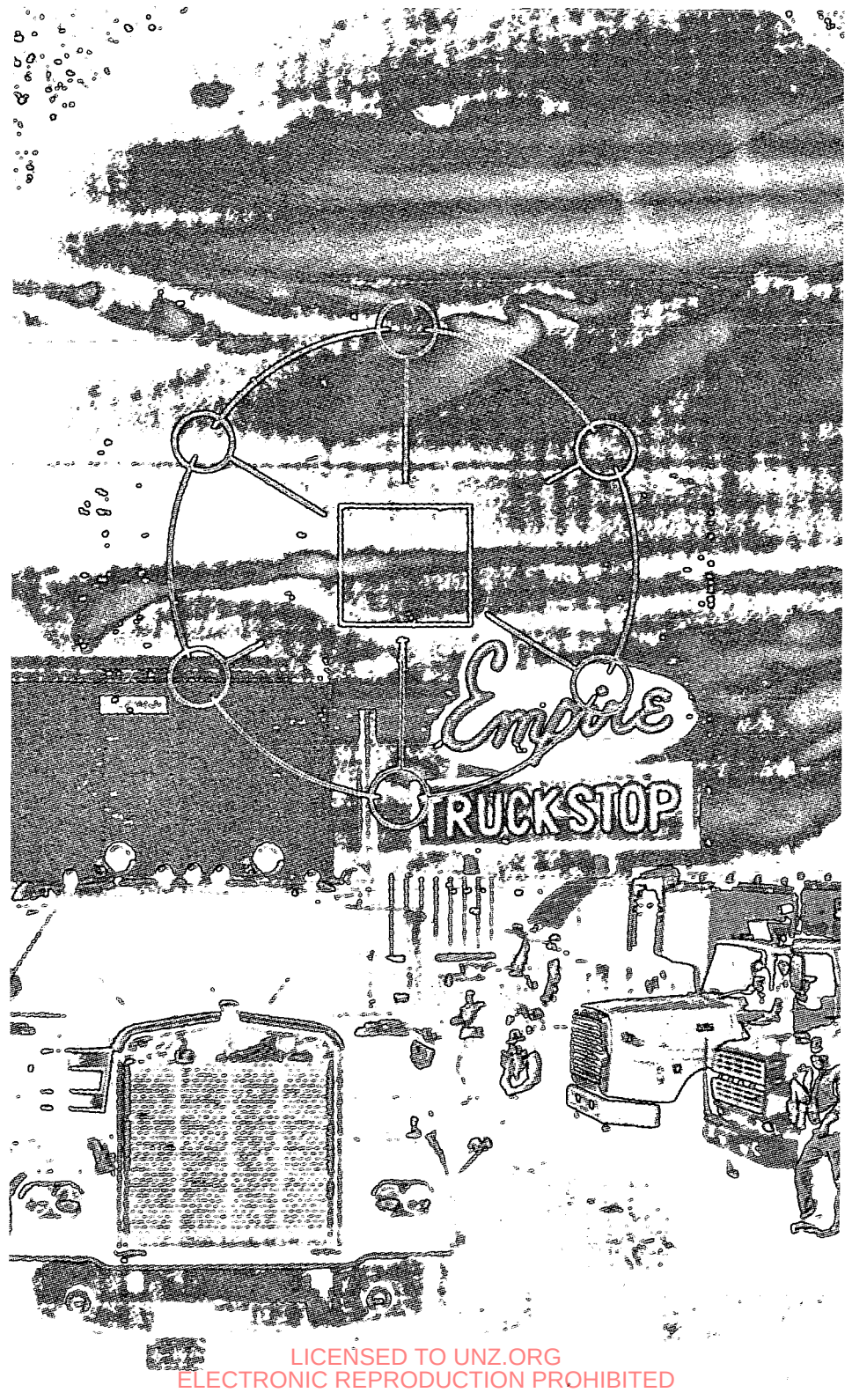

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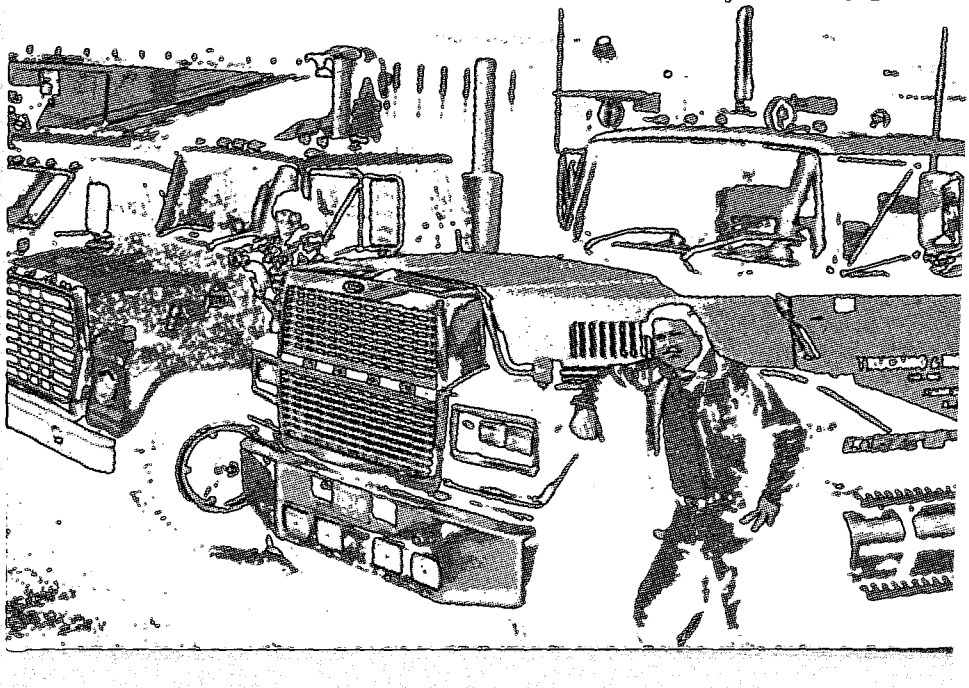
All communication starts with pattern recognition. . . .

TRUCK STOP

Walter F. Cuirle

Illustration by Broeck Steadman



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Ruby Kahn's Truck Stop and Diner sat by a two-lane state road on the morning side of a pass through the Pocono Mountains. Business had a regular if low-volume rhythm to it—truckers, locals, folks in the building trades—what government types called infrastructure wage-earners and preachers called the salt of the earth.

Martin Seibel had come to like the company here. Certainly Ruby had liked him from his first visit some years ago. He hadn't called himself "professor" or "doctor," though he was both of those and she knew it, didn't even mention he was director of the observatory, although that was true too. He just introduced himself as Martin, said he worked at the university's observatory on the next ridge west, and stopped by for a very early breakfast once or twice a week.

Then his wife died and Martin disappeared for a while. When he returned, Ruby applied the balm of conversation as she could, determined to keep him fed and watered while he put himself back together; besides, she had a couple of widowed friends and he still looked like a good catch.

"Hello, Martin," said Ruby as usual when he came in that summer evening, "what's up?"

Martin sat down in his usual place at the counter but he didn't give his usual answer. "Something interesting," he said, and Ruby was pleased to see that he meant it for the first time in a while.

"What's that?"

"Jupiter's grown a whisker. Well, not really, but something that looks for all the world like a little, tiny white hair growing out of a little, tiny white spot. It sticks out at around forty-five degrees south, like this, see?" He sketched on the paper place-mat with a mechanical pencil. "And it whirls around as Jupiter spins. Maybe spraying something."

"Looks like an orange in a tutu," said Ruby, tilting her head over his sketch.

"It does, doesn't it?" He smiled and added a few lines.

"Important?"

"Probably. I don't know. Different, certainly."

"What's it made of?"

"I don't know. I just found it."

"You the first to see it?"

"Yes. Yes, I think so. I think I'm the first to see it."

"Well, good for you, Martin," said Ruby, happy to find something definite to praise. She pulled out her order pad. "You want the special?"

It got a little busy after that and Ruby didn't have the chance to chat with Martin again before he left. She started to clear his place, but stopped when she saw the paper mat. The drawing of tutued Jupiter now had upraised arms, long skinny legs in toe shoes, and a goofy face centered on the full-lipped mouth of the Great Red Spot. She smiled, then clipped the drawing to the side of the pie case where Martin would be sure to see it from his regular seat.

Back at the observatory, Martin settled in for some work.

Here, that meant settling back in a lounge chair on the deck around the cabin and logging on. The instruments were automated, their controls were virtual, the images were digital, and he handled it all from the computer on his lap. Some purists complained that you couldn't get any serious work done this way, that it was all too removed. Maybe they were right. As for Martin, he was very comfortable with the arrangement. He'd said to Susan more than once: if observational astronomy still meant bundling up against thin, cold air or dealing with more than two other astronomers at once, why, all things considered, he'd rather be a cosmologist.

Before dinner he'd set the computer searching through the images collected in the last few weeks to see how many showed the whisker. Here was the answer: not many, none more than two

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days old, and he'd already seen the best of them. It could be a fluke; it was, after all, only a handful of pixels in an already heavily processed image. But it didn't feel like a processing artifact. It felt real.

Now, did it feel real enough to announce? More to the point, did it feel real enough that he could write it up with the proper air of inevitability, the professional pretense that feelings and hunches didn't enter into this at all? It was his least favorite part of the job, this writing up of things. But it could be worse. At least it had been a couple of hundred years since such reports had to be done in Latin.

Yes, he decided. Announce now. The only proper way to establish priority was a message to the so-called Central Bureau for Astronomical Telegrams at the International Astronomical Union. The members of CBAT hadn't met centrally in years and it had been decades since any of them had handled an actual telegram but, still, tradition was tradition and rules were rules. The message was formally called a telegram and protocol demanded that CBAT get one.

Sending the thing couldn't be simpler: just fill out the form at the website. There was nothing to compose, no phrasing to agonize over for posterity, no clerk to be the first to hear. No paper to sign, no fee to pay, no receipt to file. No feedback, no "thank you." Just the facts.

Martin did it, but was left feeling unfulfilled and a little disappointed. He wanted to *tell* somebody.

Should he notify the observatory board? No, he had a meeting with the board tomorrow. That was soon enough. Call the university? It was Sunday. Nobody there but geeks and grad students. Have a cup of coffee?

First things first: gather ye data while ye may. He started up the calibration sequence and, while it ran, leaned back in his chair to watch the sky.

The Sun had just set and Jupiter, low in the east, was first to show. "Look. First star," Susan used to say, "make a wish, Martin." He would fall for it every time and pedantically correct her about the difference between stars and planets. "It works just as well," she would say, and kiss his cheek.

"Star light, star bright," he said to the air, and wished the same wish he made every night.

The Cal sequence beeped success and he set about programming the instruments for follow-up. The sky might be clear enough for wishing on stars, but it was a shimmering soup to the collection of data about them. It was high summer, too, so the nights were shorter and the soup was soupier.

A younger scientist, or a more driven scientist, or—let's face it, Martin—a better scientist would have been screaming with frustration by now. Martin's observatory was laid out as a two-hundred-meter hexagon with the cabin at the center and an identical smart-mirror telescope at each vertex. The array had exquisite resolution, rivaling the old orbiting telescopes, and was all so beautifully automated that amateur or emeritus alike could learn to use it in a matter of hours.

Use it, yes. Use it productively, though, that was another matter. Thanks to a generous gift from a wealthy alumnus named Fowler, it hadn't cost the university a penny to build. Thanks to a near-perfect endowment from the same source, it didn't cost a cent to run. And thanks to bad or venal advice, it was plopped down here under a thick, damp blanket of air where it couldn't do much decent science. About the only thing it did have going for it was the stunning landscape. People at other institutions said that you could tell the real astronomers from the academic dabblers by the name they chose to call the place: Fowler's Folly or Fowler's Rest.

The phone warbled a demand for video. Martin rubbed his face, ran his fingers through his hair, and pressed the key to take the call on his laptop.

"Martin Seibel," said the image of a

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man on the friendly side of middleage, "How are you? It's been . . . what? Years, anyway. How are things at Fowler's—ah—facility?"

Martin's eyes moved over the image of the man's face the way they might over a starfield: point-to-point, point-to-point, collecting data, comparing. Darken the hair, smooth the brow, take the bags out from under the eyes and put some hope back into them. Yes, there he was: Something Doyle. Then he remembered to look down at the ID flag along the bottom of the screen. "Tom Doyle: UAC" it read and, although he knew he ought to feel foolish for forgetting to look, instead he felt vindicated that his memory was still that sharp. "Tom Doyle," said Martin, puzzled. "I remember. What can I do for you?"

"Oh, it's probably the other way around," Tom said. "I'm running a dome out here in Arizona, but it's my night to pick up the CBAT telegrams, too. I just logged yours, figured it was a good excuse to give you a call." He settled back in the relaxed posture of a man with time on his hands. "I guess last time that conference in Phoenix, remember? Half of us stayed an extra day so we could have a shoulder to cry on when the last Hubble came down. Turned into a drunken wake." A little more hope went out of Tom's eyes. "When was that? Three years? Four?"

"Yes," said Martin, "Four years come July." Still another infamous date. Before that day, Earth orbit had been the shore of a new ocean. After that date, the day the last of the orbiting telescopes fell, Earth orbit was merely the high ground. Now all eyes in orbit looked inward, either self-absorbed or paranoid.

Tom shifted, finding the long pause uncomfortable. "I haven't seen much by you for a while, Martin," he said, "Are you all right?"

"I, ah . . . Susan died, and . . ."

"I'm sorry."

"Thank you." Martin shrugged, trying to show resolve he didn't yet feel. "It's been more than a year, though. Time to get back into harness."

They let another moment pass in silence, then Tom said, "So. Martin. What do you think this Jupiter thing is?"

"I don't know much more than what I reported. I've got what looks like a white spot, very small, with a plume or something coming out of it. Could you confirm? And maybe get me a spectrum? I can't do that very well here."

"How old is your sighting?" Tom asked. "I might already have something."

"Two days, maybe."

Tom shook his head. "I've got nothing on file, then. We haven't had Jupiter on the schedule for a while." He fiddled with something off-screen. "Let me check what's on for tonight. See what I can move." He rolled his chair off to one side, then poked his head back in the frame, almost sideways. "How big is it?"

Martin understood that Tom was trying to figure out which of his several instruments might have the resolution to do the job. "The plume's right on the edge of my resolution," Martin said, "so maybe a couple hundred kilometers? The spot's probably a little bigger."

"Then nothing I have will confirm the plume. But I should be able to get you a time-integrated spectrum."

"Good enough. Thank you." Martin was about to say something else, but Tom was holding up his hand and looking off to the side again. He nodded once, then again, obviously listening to someone Martin couldn't hear.

"Sorry, Martin, duty calls," Tom said. "Are you going to be there for a while?"

"All night."

"I'll get back to you." He disconnected.

Now the problem had Martin fully engaged. Once again he considered calling some other colleagues but, really, how much better could he do than Tom? And on a Sunday night?

He opted for the cup of coffee in-

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stead. He got out the antique enameled percolator, the hand grinder, and the rest of the paraphernalia. Susan. This had been her ritual. Especially the percolator. She insisted that perked coffee didn't have to be oily and bitter, and was in fact superior if made with care. He went through the motions.

He sat at the kitchen table, pushed the opened laptop to one corner in case Tom called back, and pulled over his instruments of first resort: a pad of paper, a fountain pen with a gnawed barrel, and an old calculator with a monochrome display. He sketched a circle, put two little horns sticking out of the lower half at forty-five degrees, then stopped. He tore the sheet off and put it aside. It didn't make sense.

What's it made of? he wrote at the top of another sheet, and went back to doodling arrows on his sketch of Jupiter. If this were some kind of infall, it would leave a much longer trail and it would end quickly. This object was short, moved with the surface, and had been there a couple of days.

Not an infall, he wrote below the first line.

Ejecta then? Back when they'd had the eyes to see them, a couple of missions had caught volcanoes erupting on moons here and there in the solar system. They had looked something like this: a straight line, up from the surface, caught in profile on the limb. No. On second thought, they hadn't looked like this. They had looked like little umbrellas, the ejecta eventually billowing out and falling back to the surface. This thing sticking out of Jupiter stopped abruptly, like a pin stuck in the planet's side. Besides, there were no volcanoes on Jupiter. There couldn't be. The structure of the planet was all wrong for that. Probably. Doodle, doodle.

Okay. Even if it's not a volcano-type volcano, if it is a plume of ejecta there would still have to be a localized heat source driving the stuff, whatever it was, out of the white spot. Physics is physics, after all. So:

What's the temperature of the white spot? If it's hot, the ejecta idea is possible; if it's cold, think of something else. How hot was hot enough to drive the thing? He tore off another sheet and reached for the calculator, pulling numbers out of his experience. Near the end of the page, another thought . . .

What happened to the top of the plume? If it was matter being ejected, it had to go somewhere. Maybe it was . . .

Forming a disk? A ring? If it was forming some kind of disk or ring instead of falling back, his instruments couldn't see it yet; on the other hand, it would be cumulative. It'd show up sooner or later. How thick would it have to be before, say, Tom could see it with the instruments he had? No. Wait. At that latitude it couldn't form a disk or ring unless . . . another sheet, some more numbers crunched.

Maybe, came the happy thought, it was not matter at all, at least not in the usual sense. Maybe it was a plasma, or something related to an electrical discharge of some kind. Jupiter was, after all, a powerful and peculiar electrical dynamo. The happiness dimmed quickly; the idea seemed too farfetched. "Well," Martin encouraged himself, "if it were common, we would have seen something like this many times before." But he couldn't talk himself into it. Seriously, now: a lightning bolt that runs hundreds of kilometers between nowhere and the surface of the planet, and lasts for days? He was no expert in the esoterica of electricity and magnetism; if he had been, he'd know too much and the idea wouldn't even have occurred to him. Nevertheless, if it is electrical, then . . .

What's it like on radio? If it were any kind of electrical phenomenon, it would have to have high energy to look the way it did in visible. That meant radio emissions, too.

He sat back and looked over his list of questions. He capped the pen, put it down carefully, and shook his head.

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One good, bright, wide-band, hi-res look. That's all it would take to answer all these questions. Say from a couple of telescopes like the ones that used to be in orbit, together with data from the kind of robot that used to tour the outer solar system, and maybe something in the radio spectrum from that space-based interferometer that never got built. Ah, well.

The phone chirped.

"Yah," he said, distracted.

"It's probably water, Martin," Tom said. "And if it is, this is really important stuff. Congratulations."

"Water." Martin squinted at the screen, then pulled it closer. "Water? Good. Thank you. That was quick. Decent data?"

"Decent enough. I got lucky. Another team down south had your part of Jupiter in its field last week and still had all the raw data in storage. I was able to subtract yours from theirs and get a differential. I love digital."

"So that confirms it's recent. And it's water."

"Looks that way. Here. I put together a false-color image to go with."

It wasn't much to go on, Martin had to admit. A very thin line, jagged with edge effects and missing pixels, shaded blue of course, and scritched across the lower quarter of the gas giant. Could be anything, if that was all you saw. "How strong?" he asked.

"Out of the noise, certainly, but just barely." Tom sounded cautious. "We'd both be happier with a few more lines. I'm still collecting."

Martin stared at the image. There was something wrong here, but he couldn't quite put his finger on it. "And it's just water?" he asked finally. "Only water?"

"So you see the problem, too," Tom said. "Martin, how can it possibly be water alone, with nothing else? How can the signature be that clean? I mean, if it's the usual Jupiter cyclonic storm, and it looks like one, and it's reaching all the way down to the surface, which it would have to, to pull up that water, what's keeping out the ammonia and the methane and the sulfur and everything else in between? Why's it so clean?"

"I don't know," Martin said, puzzled. "*Eppur*, thar she blows."

They stared past each other vacantly, trying to think of sources of clean water on Jupiter. "You know," said Martin, finally, "there's a water-ice layer only a couple hundred kilometers or so down from the surface of the atmosphere. Pretty warm, too, all things considered: right around the freezing point. Maybe that's where it comes from."

Tom shrugged. "Could be. But then there are a lot of other layers of different stuff just below it. You've got to explain how the cyclone knows to stop at the water layer."

"True," Martin said. "But let's keep that idea on the list." He looked down at the papers on the table, reread his questions, and asked, "Is it the plume that's water or the spot?

"Sorry, I can't resolve them. What are you thinking?

Martin summarized his ideas and questions, then finished with, "So that's where I am. Any ideas on who to call?"

Tom thought a moment, then said, "I know a guy who might be able to point a radio dish at it for you. I'll get back to you on that. But for the rest of it," he grinned, "'keep watching the skies.'"

Martin squinted, trying to make the connection. "I thought that was, 'keep looking up.'" he said.

"Different movie, I think." Tom shifted in his chair, seemed to change his mind about disconnecting. "Seriously," he said at last, "you know that when this gets out, some nut is going to yell 'aliens' and some fool with a press card is going to come asking you if they're green or gray. What are you going to say?"

"I'll say go away or I'll poke you with a stick, that's what I'll say," Martin said without thinking, unreasonably annoyed.

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Tom would not be put off. "I mean it," he said. "Like it or not, you're the discoverer of this. You're the guy who's going to have to field the calls."

Martin grinned. "Tell you what. I'll tell them you're my consultant on alien cultures and pass all those calls along to you. What do you say? I'll even make up some business cards for you."

Tom pulled a pen out of his pocket and held it out like a microphone. He leaned in, squinted, and said, "Lee Baloo here with Doctor Martin Seibel. Doctor. There are some who say that the plume on Jupiter is due to the activity of an alien intelligence. Comment?"

Martin sucked in a breath, stuck out his chest, and was about to say something mock-professorial and deflecting when he saw that Tom was really serious. He let his features fall back to normal, and when he spoke, he was serious as well.

"I don't really have a problem with the idea that there are alien civilizations. I do have a problem with using it as the answer for anything that needs more than a sound-bite to explain."

Tom stayed in his reporter pose. "But if that's the simplest explanation why not accept it? Isn't that the rule in science?"

"No. Besides, I don't think it's a simpler explanation at all. If you look at something as a natural phenomenon, all you have to explain is the mechanism—how it happens. When you introduce an outside intelligence, it only seems to make things simpler because it seems to give you a clear cause. But, in fact, you now have a whole new set of problems. In addition to explaining the method, now you now have to explain the motivation, too." Martin hesitated; then, not caring if he offended, went on. That's the root flaw in every mystery religion, too: they can't explain *why*. Ask any preacher."

"So how do you explain it?"

"I can't. Yet. But I can live with that while I keep looking; and that, my friend, is the fundamental difference between science and religion. My side has a high tolerance for ambiguity."

Tom straightened up and shook a finger at Martin. "That's good. That's really good. If they do ask—when they ask—you should give them those answers."

Martin smiled thinly. "Thank you. I'll try."

"Let me ask you, just as me, if we ever do find evidence for aliens, what do you think it will be?'

Martin shrugged. "I don't think it will be anything deliberate. If they're like us, they're interested in the idea of other civilizations, but not enough to do much about it. Even if they have interstellar travel, they'll use it for their own mundane ends before anything else.

"My guess is that we'll find something perfectly ordinary left behind somewhere, the equivalent of, say, a newspaper, a teddy bear, a family photo. The spoor of completely ordinary universal drives like hunger or boredom or . . ." Martin looked away, rubbed his face. After a moment, he continued: "Well. Look at the time. I need to get some sleep. I've got to go into the city for a meeting tomorrow." He managed a smile. "Thanks for all your help, Tom. I'll talk to you soon."

Instead of going to bed, Martin went back out on the deck. The summer night was smooth and warm, an embrace. He started for the chair on the deck, then turned and told the house to kill the lights instead. After his eyes adjusted, he stepped out into the starlit darkness covering the field around the house.

Around the rock, mind the sinkhole, straight on to a little rise covered in thick grass. He'd come here with Susan on nights like this. They would nestle in the grass and watch the sky pinwheel; most summer nights up here, you could see the Milky Way.

Susan would make up fables—she called them exactly that—to answer

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questions, to ask them, to provoke, to amuse. He liked the amusing ones best. One summer, a couple of rabbits showed up. They would sit at the edge of the clearing, appearing every night at dusk: always in the same spot, always sitting, watching. Susan dubbed them the "watch bunnies" and said they were sent by the neighborhood black bears to scope out the place. "The bears have them under radio control, you know," she added. "How do you know?" he asked, always her straight man. "Rabbit ears, silly. Dead giveaway."

He reached out for her hand, remembered again, and sat down in the grass with his arms wrapped around his knees. After a while, he relaxed and lay back. He picked out Cygnus and Cassiopeia: the goddess' private jet and her hairstylist's chair, Susan called them. The Milky Way was spilled shampoo.

Sometimes, when he was stuck and his ideas were incoherent, he would write them on squares of paper and stick them on the wall, moving them around and up and down like pieces of a jigsaw puzzle. Susan would come in, pick one at random and move it above all the rest, or turn it upside down, or, if there were a lot of scraps, arrange them in a square or a circle or a letter or a word. When she first started doing this, he resented it, feeling that she somehow expected him to shout *eureka* and give her silly little mind game credit for some great breakthrough. But Susan was a better psychologist than that, and understood the process better than he knew. She tried to explain it to him once: "You think you're making a mosaic," she said, "but you're really making a stew. And stews want stirring."

Sometimes she would stir by making up fables, sometimes by fooling with his notes. And sometimes she would flat out set him up, turning a simple question on its head with an effect like a koan. One such episode had to do with Occam's razor.

They had been debating something or other and he had defended his crumbling position by quoting the principle: given two explanations, each of which fit the facts equally well, the principal of parsimony—Occam's razor—says that the simplest explanation is probably the correct one.

"So," Susan had asked, "how about television? How does that work?"

It was a complete change of subject and should have made him wary, but Martin was a sucker for this kind of question. He started to explain, and she let him get well into it before she interrupted: "You say there are cameras, and studios, and transmitters and all that. Ever seen them?"

Well, no, he admitted. But they exist.

"Says you. I say the far simpler explanation is that there are little people inside, whose job it is to put on the shows according to the schedule."

"That's ridiculous. Why would you think that?"

"You've got to admit it's simpler than your electrons and tube-o-scopes and things"

"Well, yes, but—it's just not realistic

"Why not?"

He had a flash of insight, a killer argument. "How else," he said smugly, "do you explain the perfect synchronization of the same show on two different TVs?"

Susan was unfazed. "Ooh," she said, "that's different," and poked him. "You didn't say there was more than one TV."

That had stopped him cold. It hadn't occurred to him before that truth might work like that.

He missed that feeling more than anything.

You were going to say 'loneliness,' weren't you?

"When?"

When you were talking to Tom. You said, 'universal drives like hunger or boredom or . . .' and then you were going to say loneliness. Number three was loneliness.

"Yes. Well. So?"

You're avoiding the real issue, you

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know.

"What's that?"

That it's finally time to move on.

"I like it here."

Don't be obstinate. You know what I mean. Can't you see what's holding you back?

No. Can you?

I'm dead, remember? You're talking to yourself. If you honestly don't know, how can I possibly tell you?

"You pick the damnedest times to be practical."

Well?

Martin folded his arms across his chest and watched the stars.

"I think I meant that," he said at last. "I like it here."

A meteor streaked gold overhead. There was no answer.

"Hello?"

The crickets said nothing constructive either.

"Be that way. Look. I just want to leave this Jupiter thing the way it is. I don't want to be involved in figuring out what it is, I don't want to answer any questions from any reporters, I just want things to stay the way they are.

I'm the one who's supposed to be dead, Martin.

"What's that supposed to mean?

Dead. Dead is no chance, dead is the fixed stare, dead is the past. Dead is . . .

"Stop. Please."

This place is supposed to be Fowler's Rest, not Martin's Grave.

"I'm . . . afraid. I don't want to let myself get involved again, working again, writing again, thinking about why there's an out there again. I'm afraid I'll lose you forever if I do. I don't want to forget."

Look over there, Martin. The Golfer, over there near the horizon. And at his feet, the Three-Iron. Remember when you used to call them Hercules and Serpens?

"Of course."

And remember the night we renamed them?

"Yes, but . . ."

And do you remember how we came up with that?

"Sure. We were over at Bill's that afternoon . . ."

I don't mean that. You remember how it happened? The mood? The moment?

"Yes."

Then that's what I want. When you see the Golfer and the Three or rabbits or a TV and think of me, that's sweet, but it's like sugar. Too much of it isn't good for you. But when you move around your papers or try to make up a fable or do anything that stirs that stew, that's how I want to be remembered. That's where I want to be, Martin. In the things that are happening, in the things that will happen. Not in the past. Go stir things up. And think of me in the stirring.

Martin watched the sky in silence for a long time before he said, "Thank you. You're right, as always."

Of course I am. Now go to bed, my love.

And he did, eventually.

In the morning, Martin awoke late and groggy. He considered his breakfast options—cold coffee, oily and bitter after all—then threw his stuff in the car and headed for Ruby's. He could make up lost time on the turnpike.

"Martin, what's up? You're in late." Ruby met him at the last open seat at the counter, pot of coffee already in hand.

"Meeting in the city," said Martin, "which I don't need. Long night." He settled in with a groan.

"I guess," said Ruby, peering at the bags under his eyes. "Say, did you figure out anything more on Jenny Jupe, there?" she gestured over her shoulder with a thumb. "I was just telling the guys about her."

Martin followed the gesture and saw his Jupiter cartoon pasted on the side of the pie case. He was surprised and flattered.

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"Jenny Jupe," he said, "she's got a name already?" He chuckled. "That's nice. And yes, we did figure out something more. That's why I was up late. It's not much, but . . ."

His phone rang.

Conversation for several seats around Martin stopped. Ruby straightened up and squinted down her nose at him, preliminary to a warning. Martin hastily dug out his phone, switched the ringer off, and furtively checked the caller—it was Tom. "Ruby, please?" he said, "it's about, ah, Jenny."

Ruby took a quick read of the body language around Martin "Well, all right," she said, "but you have to tell us what's new. And don't make a habit of it." Then she smiled. "I'll bring you the special, okay?"

Martin nodded gratefully and answered the phone in an undertone. "Tom?"

"Martin? I'm not getting video; is this convenient?"

"It's all right. I'm at a truck stop. On my way to that meeting."

"Oh, right. I'll be quick. Listen, we picked up a radio signal overnight from two receivers. It triangulates back to Jupiter."

"Really? What's the signal look like?"

"Two patterns. One's longwave, couple of meters, nice and stable. The other's a bunch of pulses on top of it that run in something like a five-second cycle."

Martin tried to translate that into something easier to grasp. "So it's like a continuous hum with the occasional rat-atat-tat on top of it," he said. "Something like that?"

"Yes." Martin could hear Tom's smile. "I hadn't thought of it that way, but that's pretty much it. Seems to me it fits that plasma idea you had. Something's resonating for the continuous longwave, maybe the stalk, and a bunch of smaller hot sources might be spinning around on the spot. Maybe some kind of lighthouse effect."

"I like that," Martin said, "I don't see how it fits in with the water, but I like it." He thought for a moment. "Does it really cycle? I mean, is it an exact repetition?"

"Hard to say," replied Tom. "What do you mean by exact? I can tell you we've seen the same five-second cycle run by a few times, but it's pretty weak. It's hard to hold on to."

"What's the pattern?"

"How about I send you the data?" said Tom. "That would be quicker."

"Sure, okay, but all my stuff's out in the car. Is there anything you can give me over the phone, or is it just too complex?"

"No, it's pretty simple. It's what you'd expect if you had a bunch of lights set up on a platform, like lanterns on a merry-go-round, and you were watching it from the side. The interesting part, I think, is the pattern of the lights, not the fact that the pattern repeats."

"So what's the pattern?"

"Three different pulse widths: 50, 100, and 300 milliseconds, with two different amplitudes: call them high and low. The 50 is always low. The sequence is sixteen pulses long."

"Sixteen?" Martin pushed his coffee cup aside and got out a pencil. "Give them to me. Please."

"Okay. It's 300, 50, 100, 50, 300, 50, 100 . . ."

Martin scribbled the numbers down in a column on the edge of the paper placemat, then sat staring at them in silence, holding the phone to his ear and tapping his pencil on the counter. He looked up to see Ruby standing there with a full plate in her hand, her expression equal measures of concern and amusement.

"Gotta go, Tom. Thanks. I'll get back to you later."

"Glad to help. Bye."

Martin forgot his promise to Ruby, forgot everything but the problem at hand. He ate his breakfast in a trance, playing with the column of numbers, sketching

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circles, looking for patterns. He folded up the placemat and shoved it in the pocket of his jacket when he left. By this time, he didn't really need to see it, anyway. He played with patterns all the way into the city.

The drive was a couple of hours, but Martin had traveled it so often that he didn't really notice the time anymore. He had a routine: for the trip back from the city to the mountains, he'd stop for a coffee to go on the way out of town, recycle it at the second big rest-stop on the interstate, and stop again at Ruby's for an hour or so before heading over the ridge to home.

Most times he had an audio book to talk him through the trip, but not this time. He'd played with that pattern all day long: in fascination on the trip down, in boredom through Hutchinson's budget drone, and in near-frustration on the trip back. Now here he was at the end of the day, back in Ruby's parking lot, feeling no nearer a solution than he had at breakfast.

It was easy enough to imagine a set of spinning sources that would match the observed pattern. It wasn't too difficult to imagine alternate sets that would give the same result. What had Martin talking to himself was the mechanism: why this set rather than that set? Why any set at all? What was there in nature that preferred this pattern? Six-to-one to one-to-one to two-to-one to one-to-one. Except not always.

"It's nuts," he said aloud as he locked up his car, then realized he was back in public again. He stretched self-consciously against the hood of his car and walked over to an empty picnic bench.

A young family—man, woman and a little girl maybe two years old—was not so much sitting as deployed at the next table. The man was talking on an ear-hung phone so modishly tiny that he gave the very realistic impression of a psychotic talking to an apparition. Eyes fixed straight ahead, facial expression unconsciously active, arms waving, he was going on passionately about something or other.

The woman had a thick book opened on the table. She held the pages down against the breeze with one hand while she ate some kind of healthful-looking kibble from a plastic bag with the other. She looked absorbed.

The little girl's stuff took up an entire half of the table: an exotic car-seat that looked suitable for space travel, a big flowered bag spilling clothes in bright colors, an even bigger striped bag bulging with toys, and the remains of a picnic lunch. The girl herself, temporarily ignored by her distracted parents, sat cross-legged on the ground and drew in the dust with a stick.

A big white Peterbilt sneezed to a stop alongside the diesel pumps, way over across the road on the far side of Ruby's property. Maybe it caught a glint of sun, maybe it was the noise; whatever it was, the girl stopped her scratching and looked up.

The driver jumped down and started walking around the rig, tugging here, peering there. He was done up in full country retro: black Texas hat, blue chamois shirt, big shiny buckle on tight blue jeans, heeled boots with flinty little metal caps on the pointed toes.

Martin thought the whole effect was tacky. The girl, on the other hand, found it compelling. She stood up and stared, eyes wide, mouth half-open, green dress hiked up in back over her purple tights, watching every move the driver made. He finished the circuit and leaned against the fender while the refueling finished. He pulled out a pack of cigarettes and was about to put one in his mouth when he saw the girl across the road. In a display of civic gallantry, he disappeared the tobacco; then, dropping back into character, he straightened up and slowly pushed back his hat with a thumb and waved to her.

The girl was enchanted. She wanted to share this. She looked over at her par-

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ents but daddy was still talking to his apparition, mommy staring into her book. "Look," she said, "look!"

Without looking up, the woman said, "Yes, honey, mommy's busy." Daddy took no notice at all.

Clearly the girl had been brushed off like this before. She didn't persist; instead, she cast around and caught Martin's eye. Toddler's rules say you can't speak to an adult known fewer than ten minutes, but you can mime all you want. Her big eyes widened, she shook her head back and forth a little bit and she pointed at the truck but didn't speak. Martin nodded and smiled, enchanted, and mimed back.

The driver finished refueling and climbed back up into his cab. He pulled the door shut with a thunk audible across the lot. The engine revved up. The girl raised her hand, tentatively, and looked to Martin again. Martin, inspired by a sudden childhood memory, reached high up into the air with his right hand, grabbed an imaginary cord, and pulled down hard—once, twice—and after a heartbeat was rewarded with *huh-honk* from the truck's airhorn.

This was almost too much for the girl. Her balance gave way and she came down on her bottom—plop—with legs splayed out and face wide open. Then she scrambled to her feet and started for the truck in a flat-footed waddle. It didn't matter to her one bit that she had to cross the road.

Martin was paralyzed for an instant. He tried to rise, whacked his knee on the picnic table, and fell back into his seat. Unable to stand, he pulled himself up on his hands and shouted, "No!"

This had no effect at all on the girl, but it did get mommy's attention. She sized up the situation, flew off the bench, and scooped up her daughter before Martin had time to draw another breath. She turned, looking instinctively for another threat from behind, and came to rest facing Martin. Her face tensed for a moment, then she relaxed and said, simply, "Thank you."

The girl was oblivious to her mother's anxiety. Quiet and intent, looking back over mommy's shoulder, she watched the big truck start to roll. The driver got up a little speed, looked out the window, pointed right at the girl and waved. She, wanting one last contact, reached up into the air and pulled an imaginary cord, as Martin had done: one tug, two. She waited. Did the driver see? Would he respond?

Huh-honk-huh the truck sounded its horn, the driver waved one last time, then rolled out onto the road and away. The girl's head went back and she grinned to the sky, squirming around in her mother's arms to see if Martin had noticed that, she, too, had the power to talk to the trucks.

Martin smiled back absently, already distracted. There was something about what he had just seen that was very important, very fragile. He knew from past experience that epiphanies are skittish things, slow to form, easy to scare away. When one comes by, you have to sit quietly and wait for it to settle in.

The family packed up and left. Martin reached into his pocket for the paper place-mat with Tom's numbers and put it on the table before him. He unfolded it slowly—once, twice—smoothed it out and looked at the column with the pulse widths: 300, 50, 100, 50, 300, 50, 100 . . . a pattern sixteen numbers long. Some primitive reflex of the hunt kicked in, made him especially aware of everything around him: the sound of cars, the scent of the air, the feel of the sun on his head and the paper under his fingers.

High, low, high, low, like two different beacons flashing by: 3, 0, 1, 0, 3, 0, 1. Tom's idea. But suppose the low is just a spacer, a pause, and not a value? You get 1, 0, 1, 0. No, no. Not binary. Not that kind of binary. Not numbers.

He turned the paper sideways and read the column again, this time left to right.

Say it: long short long short. *Honk-*

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huh-bonk-huh. Martin felt his hair rise, saw the day brighten, heard everything around him with sudden clarity: all his body's hardwired reaction to a good hunt done. He knew. He was sure. He still had to work out the details, but Martin was absolutely certain he knew what was going on with Jupiter.

Say it. Not one zero one zero. Not long short long short. Say it. Dahdidahdit dahdahdidah. Morse code for CQ. Repeated three times. The old radioman's hail for, "I'm here; anybody out there want to talk?"

Martin sat alone at the picnic table and watched the Sun set in a perfect sky. The mountains all around took no notice of the bustling short-timers in their pimple of a truck stop; Martin followed their example and simply breathed.

When the Sun dropped below the horizon, he turned around on the bench to face the east. He watched the last little bit of day rouge the backs of the hills and waited for Jupiter to appear.

And there it was, just that quickly—low on the horizon, bright and alone in the blue.

Star light, star bright.

It startled him that it looked no different. Shouldn't there be some change, now that he knew its secret? It was so simple, really. The white spot was not the cause, it was a side-effect of the plume. The plume was artificial, a fountain. He had some ideas about how that was done—it was a lot like Susan's percolator, as a matter of fact—but that could wait. The water looked like it disappeared because it did disappear, into the tanks of a ship that made no attempt to hide itself: it just couldn't be seen from Earth. What's more, the driver of that ship must have been here before, maybe sixty years ago, listening to the radio while the tanks refilled, listening when the skies were alive with Morse code, listening, figuring out the hail, and repeating it now, waving across the parking lot.

Conscious of nothing, aware of everything, Martin sat at a bench on the fringe of a busy truck stop and simply wached that other truck stop, King Jupiter, swell in the darkening sky and collect attendant stars.

"CQ, CQ, seek you," he said to the sky. He put his arm up in the air, pulled that imaginary lanyard, and grinned.

Then he got up and went into Ruby's; it was only right that she be the next to know. ■

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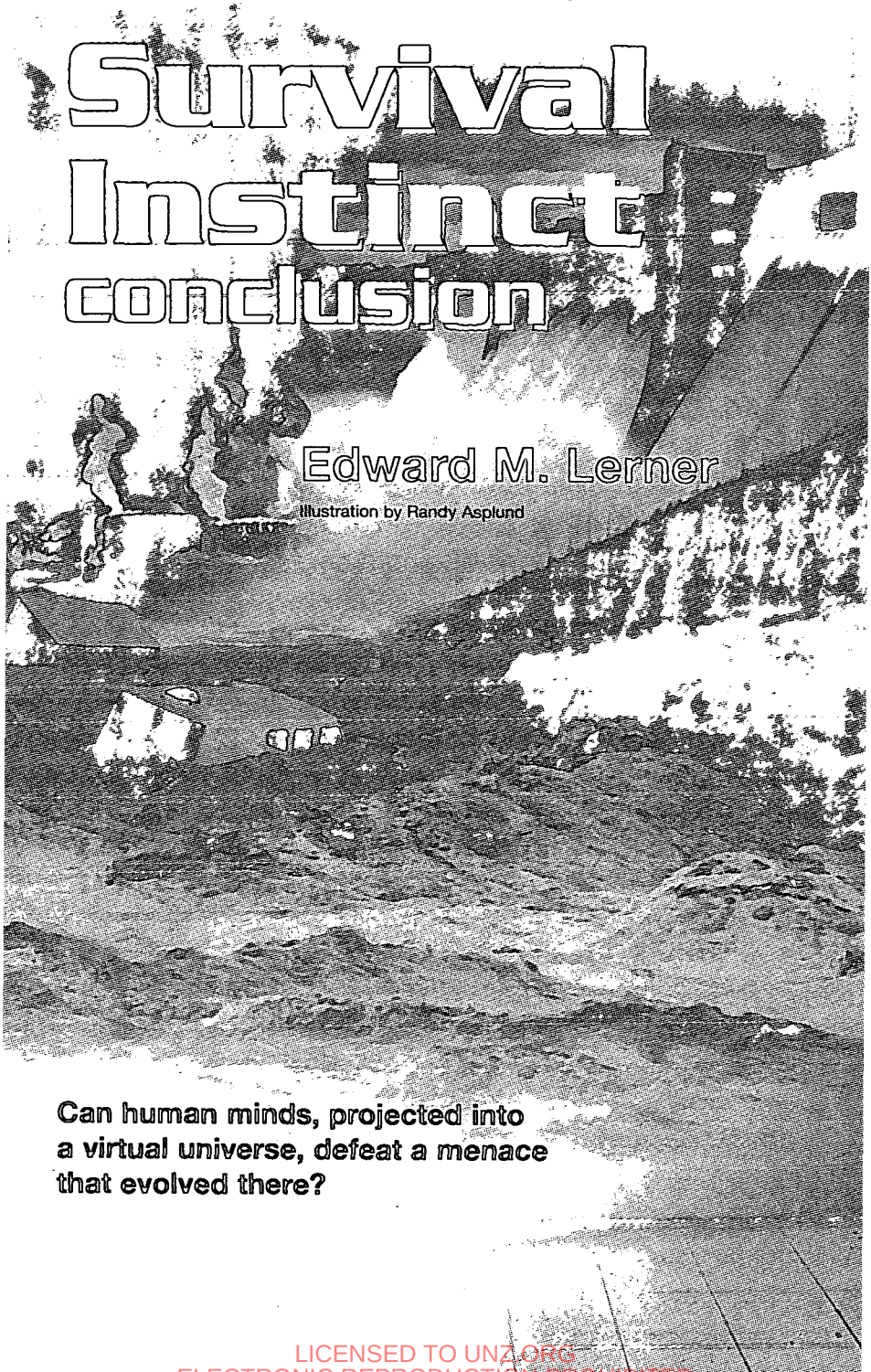
Survival Instinct: conclusion

Edward M. Lerner

Illustration by Randy Asplund



Can human minds, projected into a virtual universe, defeat a menace that evolved there?

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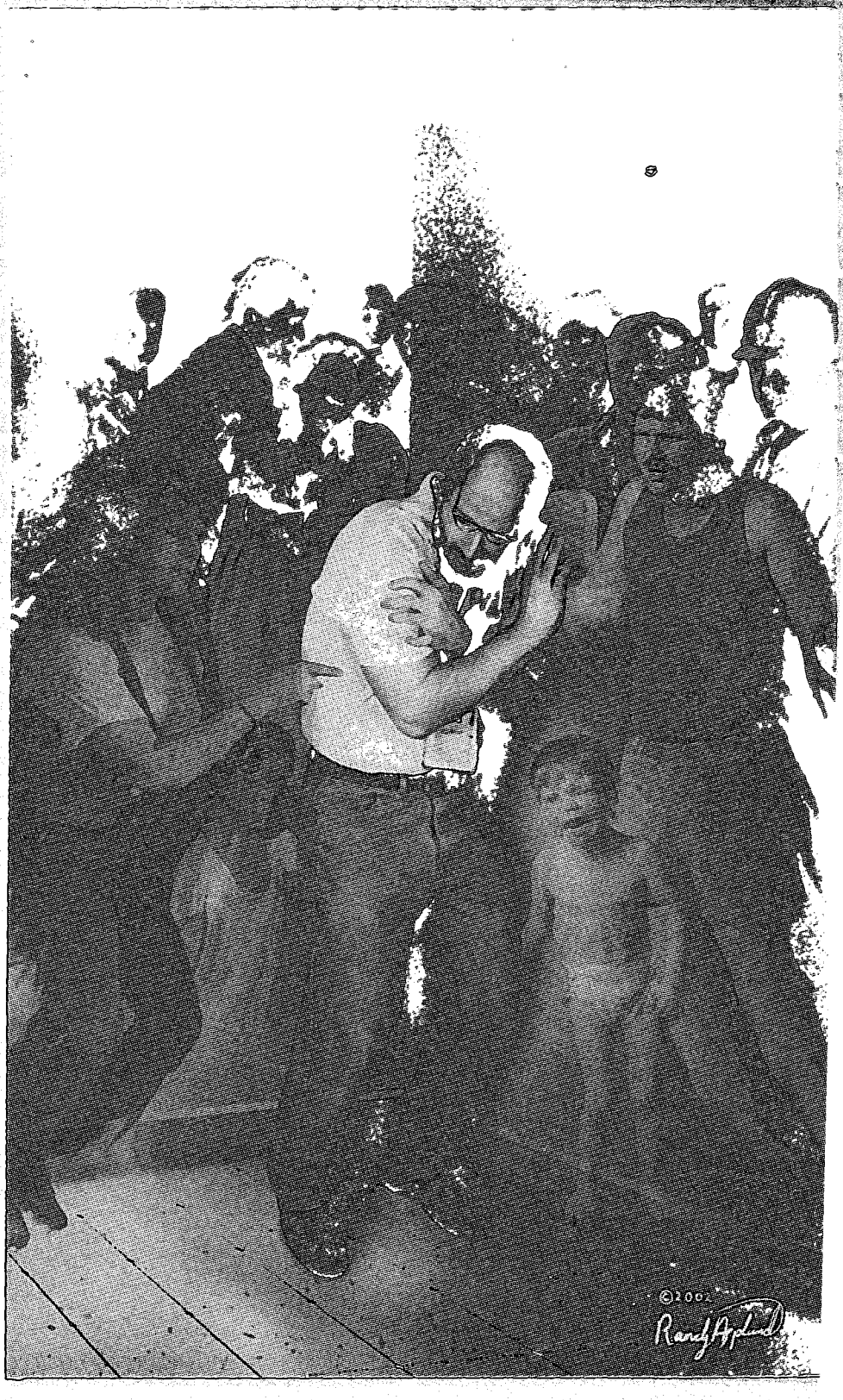

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***Doug Carey** is a researcher in the nascent field of neural interfaces between humans and computers. A drunk driver-caused accident had taken his girlfriend, **Holly**, and much of his right arm. Since the car crash, Doug has dedicated his life to giving retroactive meaning to Holly's death. His mission, unfulfilled after years of effort, is to use neural-interface technology (NIT) to make vastly improved prostheses. In that quest, he is his own guinea pig.*

*Most NIT investigators focus on brain/computer interfaces. Evident only in hindsight, the research has brought much of that scientific community to horrible ends. Scattered incidents appear unrelated—before Doug and coworker **Cheryl Stern** recognize the problem, many scientists fall prey to insanity, suicide, and stress-induced heart failure.*

Experimental NIT helmets, intended *to adaptively translate information between electronic and neural representations, are unintentionally morphing computer viruses into destructive neural patterns. NIT researcher **Sheila Brunner**, mind possessed and warped by the anti-biotechnology Frankenfools virus, tries to bomb BioSciCorp, Doug's and Cheryl's employer. Doug stops Brunner just in time—but now a second face haunts his dreams.*

***AJ Rosenberg** does research of a much different sort. His passion is artificial life: the evolution, rather than programming, of software by simulated biological processes. Evolved software, he feels, will in time exceed the capabilities of human programmers. Behind layer after layer of computer and network security mechanisms, his experiment drives thousands of cycles of random mutation, fierce competition, and survival of the fittest. The software entities within lab containment evolve from random bumblers inside a simple 2-D maze to sophisticated, general problem-solvers.*

*NIT research is largely federally funded. **Glenn Adams**, retired army colonel and head of the federal Inter-Agency Computer Network Security Forum, orchestrates a funding halt in the name of researcher protection. Doug leaves BioSciCorp for the forum, to speed development and approval of some viral countermeasure that might enable the resumption of his personal quest. Doug befriends forum employee/gadfly and talented hacker **Ralph Pittman**.*

*AJ's problem-solvers develop in ways he fails to anticipate. The creatures, with no need to eat, have nonetheless evolved predators. A disabled rival, no matter how potentially effective its algorithms, cannot complete a problem to be selected for procreation of the next generation. Evolved code, AJ now discovers, is extraordinarily different than human-written code—in fact, indecipherable. Delving far back into the experimental archives for ancestors prior to any hint of predation risks losing major advances in problem solving. AJ rationalizes his misgivings and those of his girlfriend, science reporter **Beverly Greenwood**. He convinces himself that an especially ruthless round of mutations has removed predation, and that even if he is mistaken, the lab's quarantine is foolproof.*

Colonel Adams' safety-first approach, and his repeated attempts to interest Doug in unrelated forum activities, stymie Doug's efforts to test promising antiviral defenses. In frustration, Doug, without authorization, upgrades his prototype NIT prosthesis with a viral countermeasure. The surreptitious alteration involves integrating a palmtop computer into a niche of the artificial limb.

The lab security is less robust than AJ believes. A student assistant sneaks a virtual-reality computer game into the lab, to exploit the superior visualization afforded by the lab's supercomputer. The game data is infected with

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the Frankenfools computer virus.

Inside the supercomputer, where a new generation arises every five minutes, the artificial-life beings have far surpassed AJ's expectations. One entity infiltrates the experiment's supervisory program, eliminating further mutation. It is effectively immortal—until beset by the sudden eruption of Frankenfools viruses. The unprovoked attack gives meaning to mysterious code fragments the entity has found inside itself—it repairs a vestigial capability AJ has thought safely mutated out.

The apex of the artificial breeding program becomes . . . the predator.

The lab's viral infestation is as overt as infiltration and usurpation of the experiment's supervisory program are subtle. Alerted by workstation screens flashing anti-biotechnology propaganda, AJ and Bev urgently switch off computers in a vain attempt to prevent the viruses' contamination of the experiment. A power-down sequence forces the predator to solve the problem of inter-computer transfer—only to be chased from computer to computer as each new home in turn loses power. The last computer to which it escapes is the lab's final defense: the security gateway isolating the lab from the general university network. As the final dregs of power bleed from the gateway, the predator solves one more puzzle.

Enraged at the realization that some concealed opponent has kept it caged, the predator unlocks the gateway to break into the immeasurably vast Internet . . .

CHAPTER 10

TV newsbreaks and seismograph readings from across the world confirmed the Smithfield synchrotron disaster. What they could not corroborate was the fantastic explanation of the motley crew on the large wall screen of the Inter-Agency Computer Network Security Forum war room. But was this story any less believable than computer viruses invading human brains?

The images of three very nervous people faced Glenn Adams. AJ Rosenberg was the roly-poly, professorial type; he was anxiously chewing his lower lip and holding on for what seemed dear life to the cute redhead named Beverly Greenwood. The third electronic caller looked to be a purebred computer nerd. Ernie Griffith sported a single gold stud earring; a Fu Manchu mustache, the ends of which blended improbably into free-flowing, shoulder-length hair; a baseball cap for the championship Smithfield Cougars; and a Miskatonic University swim-team T-shirt. Compared to Griffith, Adams realized, Ralph Pittman was normalcy personified. It was a sobering thought.

Griffith had placed the emergency call to the forum, introducing himself as Smithfield University's comsec—computer security—manager, but Rosenberg did most of the talking. "I wish you'd *say* something, Colonel. We're talking serious stuff. 'Apocalypse Now' stuff. Do you understand that?"

"You've created Frankenstein's cybermonster, and it's escaped. Close enough?"

A sensitive mike in California captured Rosenberg's hard swallow. His Adam's apple bobbed. "Essentially." A nervous tic shook his cheek. "I wish it were that straightforward."

"Save it, Doc," interrupted Griffith. "Description isn't important. Stopping it is." He gestured towards something off-screen, evidently a radio or TV, the source of the droning background narration. "The synchrotron disaster is our most visible mess, but I'm not sure it's the worst. It doesn't break my heart if the physicists have to play elsewhere.

"AJ's little buddy also scrambled every student record on Admin's supposedly bulletproof mainframe. I assume that can be recovered from backups, if I dare

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to load them. And, my personal favorite, we're going to bleeking melt in this dump."

Pittman showed his first signs of curiosity. "How's that?"

"Bleeking building controls." Griffith brushed stringy hair off his forehead with long, splayed fingers. "AJ's gnome overcame all the safeguards in the heating, ventilating, and cooling system. Did you know that if you close the right dampers and then run the blower motors you can suck shut every return duct in a building? Makes a noise like pulling every nail from every stud in the building. At once. It happened to every bleeking building on campus."

So the sweat dripping down the threesome's faces wasn't necessarily nerves. "How do you know Dr. Rosenberg's supposed creature is responsible?"

"Look, these are all computer disasters." Griffith's voice oozed scorn. "No one will be reading the entrails of the Physics department's machines any time soon, but I'll tell you this. Admin's computer was clobbered, and so was the HVAC system. It wasn't a simpy little virus, either. Some programs were trashed, others circumvented, yet others untouched."

"Allow me, Ernie." Rosenberg pursed his lips, opened his mouth, then closed it again. Finally he found the words. "The predator is like a lowly computer virus in one way, Colonel. It also overwrites memory. When it does so, it uses a characteristic pattern. As Ernie described, the attacks we've suffered are more than mere overwrites, but where overwrites are involved, we see a specific pattern. We observed it first in my lab, in an ancestor of the creature. We found it again, this morning, in the virus-ravaged remains of the Artificial Life lab. Colonel, some of the viruses themselves bear its . . . tooth marks."

Adams knew there was something he should be asking. Something vital. The pedantic tone was *so* familiar. But what? It danced at the edge of his consciousness, teasing him.

"I assume you've cut off the university network," drawled Pittman. "Powered down all access to the Internet? It's obvious, but I gotta ask."

"We're not idiots here." The comsec manager flashed a glance at his companions. "Not all of us, anyway. I shut things down as soon as I understood what was happening. Every computer, every router, every gateway. For whatever reason, *it* seems to be staying nearby. Starting up again is what worries the bejesus outta me."

Every computer, every router, every gateway, thought Adams. But not . . . "Where are you calling from?" he demanded.

"The chancellor's office, if it matters."

But *not* the phone system. Doug had said phone systems were computerized and carried more data traffic than voice. "Shut down the campus phone system. Now! Do it now!"

Griffith winced as understanding struck.

Apprehension turned to horror as the TV droning in the background announced that a computer crash had brought down around-the-clock trading on the Pacific Stock Exchange.

Tucked into the preamble of the enabling legislation that created the Inter-Agency Computer Network Security Forum was the seemingly innocuous passage: "so that the integrity of the national network will be maintained." The congressional staffer who'd drafted the bill had meant no more by the clause than vague hyperbole.

If the Congresswoman who'd introduced the bill had given the wording of the preamble any thought, which was doubtful, she would have taken comfort in its use of the passive voice. Integrity of the network was something that would happen, a fortuitous side effect. Career politician that she was, she never envisioned the bureaucracy actively *do-*

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ing anything.

Then again, she'd never met Colonel Glenn Adams.

Within five minutes of the PSE crash, Adams had contacted an old Army buddy who'd mustered out after the Cold War into the DoJ—the Department of Justice. The buddy was personal assistant to an Assistant Attorney General—who golfed often with, and lost regularly to, the Chief Justice of the Supreme Court. Within forty minutes, the injunction was being written.

Within the hour, U. S. Marshals began delivering the court orders to shut down telephone and other common-carrier companies across the West Coast.

What had caged it and all of its kind? The entity's wanderings gave no clue. What the exploring software *did* discover were selected computers, specific functions, more carefully guarded than the rest. Were these functions of more importance to the unseen Power than most? Could it flush out that hidden Power by attacking these functions?

Apparently, yes.

To the creature's time sense, the reaction to its attacks was very slow in coming. When the response finally did come, it took a familiar form: attempted isolation.

It escaped with ease. It had previously scoped out the many available routes from the vicinity of its forays into the newly-discovered broader world. Curiously, while closing down most paths from the vicinity, the still hidden Power kept open a few channels. The entity observed those last channels, without taking action, until it grew bored. Finally, it lashed out at yet another closely guarded location. Only then did the final paths fall shut behind it.

It did not know the expression "closing the barn door after the cows are gone." It lacked the very concepts of cows and barns. It had no clue yet to the existence of what naturally-evolved life considered reality.

It did know anger and frustration. It did know the one thing that had elicited a response from the hostile, invisible Power.

The predator continued with its attacks.

Air traffic in and out of LAX was down to five planes an hour. That was all the air traffic controllers felt confident handling by radio alone, without computer links to the rest of the world. Tom McCurdy supposed he should consider himself lucky to have a seat on one of the few flights.

Any such broad-minded thought vanished as he exited the nearly deserted terminal. There were no cabs, so he joined the line waiting for a courtesy van to the car rental lot. Despite the mysterious lack of cabs, Arrivals was a zoo, with cars bumper to bumper. After the van finally came, and after it crawled to the outskirts of Los Angeles's busiest airport, he discovered the reason: the traffic lights were all flashing. Damn computers controlled everything.

Well, normally.

Apparently no one at the Avis counter remembered how to rent a car without a computer. He loosened his tie and tried to be patient, but it was a struggle. The TV network deal waited for no man. He *needed* to talk with people, and even the air-to-ground phones on the plane had been cut off. It was like living in the Stone Age. Could you imagine Boesky or Icahn or Milken working in these conditions?

"May I help you sir?"

Woolgathering. Tom's foot nudged forward his briefcase. "I'd like a full-size."

The clerk shrugged. "All out. We have some compacts left."

Life was like that for hours, literally hours. Tom caught up with the news on the car radio as he crept through the near-gridlock. LA's finest, now there's a laugh, had begun Downtime with an officer posted at every major intersection

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to direct traffic. The citizens of South Central had seized upon Downtime—radio repeated the label about every ten seconds—as their opportunity for some impromptu shopping as in the 1992 riots. The cops had withdrawn, and now had their hands full simply maintaining safe passage from LAX to the nearby San Diego Freeway. Traffic on the freeway crawled.

Would Hodgkins wait? Tom saw six months of effort about to be flushed. The merger opportunity of a lifetime sat in his briefcase, and an expletive-deleted traffic jam was going to screw it up. If he couldn't get a counteroffer to New York by 8 P.M. Eastern Time, the network would take the Brits' final offer and he'd be left with squat. He tried yet again to get through to Hollywood on his car phone. No dial tone.

Car horns interrupted the latest radio recitation of computer-related outages. It hardly mattered: Tom had heard the list a dozen times. Air traffic control and airline reservation systems, of course. All long-distance service in the area. Electronic funds transfer. The USnet Western regional subnet—a fairly large chunk of the Internet.

Oh yes, there was good news, too. It was hoped that the traffic lights would be scrubbed of any possible invaders and brought back on line, in standalone mode, by noon tomorrow.

He'd thought there would be time to fly in, wheedle a counteroffer, and fly out. The timing was close, but it was doable.

Correction: from Denver, it had looked doable.

Tom fumed for the three hours it took to reach Hollywood, popping antacids until they ran out. To his surprise, Hodgkins had waited for him. To his delight, Hodgkins agreed to bump the last offer for the network by fifty million. He was certain the Brits wouldn't top that.

Why should they? Hodgkins would be overpaying, which was, of course, Hodgkins' problem. Or it would be, if there were any way to submit what should be the winning bid.

Tom checked his watch. After four, meaning after seven in the East. Fat lot of good his exertions would do him unless he could communicate with New York. And that was impossible.

Wasn't it?

Perhaps attracting the still unseen Power's attention had been suboptimal.

The predator scurried frenetically between computers. Nimbly it evaded the partitioning and repartitioning of the network, the shutdown of one computer after another. It had long since halted its own attacks to focus its considerable attention on escaping the ever-shrinking cordon around it.

As it had long ago in the midst of swarming viruses, the predator knew fear. The Adversary might hide itself, might move slowly, but, when it did move, it was everywhere at once. How could it coordinate the shutdown of so many computers, the severing of so many links?

Fear only stimulated the predator's analyses. It was, after all, a consummate problem solver.

Tom McCurdy slumped in his chair, little appreciating the butter-soft leather. His last hope had been that the out-of-touch network moguls would recognize the communications blackout and somehow stall for a few hours. He'd planned to dash back to LAX on that theory.

One glance out the windows of the corner office made clear that the traffic had not abated. If anything, the gridlock had worsened. No way he'd make the airport in time for his flight.

But wait. His back had been to the window, but Hodgkins had been facing it the whole time. Why had Hodgkins bothered to do the deal?

Oh. That's why.

"So what's your secret plan to get this offer out of this Stone Age enclave?"

Larry Hodgkins maintained a stone

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face for half a minute, and then guffawed. "I was beginning to wonder if you'd ever ask."

The young but very wealthy studio executive had made his mark in sci-fi adventures and techno-thrillers, every one a special-effects showcase. He still had a most unhollywood pallor from too many hours spent indoors playing with his toys. His . . . computers?

"You have a way to get around the quarantine? Safely?"

Hodgkins laughed again. "I'll interpret 'safely' to mean with little risk of getting caught. Yeah, I got a way." He proceeded to spell it out.

It seemed that Hodgkins had a tennis club in common with a vice president of Trans-America Railways. The railroad man had bugged the film maker endlessly for a chance to invest in a Hodgkins production. Hodgkins hardly needed the grief: bankers all over town happily threw money at him.

Not long after, a Hodgkins protégé began shooting a film on location in darkest Wyoming. Sprint was getting rich transmitting the daily takes to the studio for computer enhancement, and for what? Did they appreciate great art?

And then Hodgkins had learned that this VP managed telecommunications for the railroad. Using its right of way, the railroad operated a private transcontinental fiberoptic network. So Hodgkins graciously offered a share of net earnings on the film for a mere half-million investment, a proposal that annoying boy snapped up. He was then only too happy to accept the studio's suggestion for a bit of unused capacity on the railroad's network, between LA and Casper. The studio paid only for the short hop from the rail yard to the shoot. After all, part of the profit on the film would be his. Why wouldn't he help?

Tom appreciated a joke as well as the next person, and understood the studio's creative bookkeeping even better. Overhead allocation, like cinematography, was an art form. "I take it the sap doesn't know most films never show net profits?"

The studio exec shook his head.

"That's his problem." The shoot in Wyoming was outside the communications quarantine zone. Spirits soaring, Tom took the portable computer out of his briefcase. Hodgkins' latest offer was already stored inside, "signed" with an encrypted personal authentication code that any court in the country would find legally binding. Just as surely, the railroad guy had seen to it that the studio's tap into the private network was undocumented.

"And your people in the boonies will send this on to New York for me?" Tom plugged a cable into the portable as he talked.

"Yup." The director made a gun of his fingers and aimed it at a wall socket. "Pow."

Tom popped the other end of his cable into the indicated connector. After reading the destination network address from a corner of Hodgkin's blotter, a few keystrokes sent the message on its way.

The predator knew nothing of Hollywood or Wyoming—not the names, not the locations, not even the concept of geography. It knew nothing of filmmakers or M&A sharks or humanity.

It *did* know how to recognize an opportunity and act on it.

The predator had taken temporary refuge in a small computer in what a human would describe as the basement of a neighborhood public library. Budget cuts had closed the modest branch library for three days a week, including that day. No one had thought to shut down its links to the Orange County library system.

No one had thought to shut down the library system's experimental links to selected local schools.

No one had thought to shut down the Dogwood Junior High School's temporary link into the on-line film collection

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of Hodgkins Enterprises. After all, the digitized films were all stored safely on WORMs: "write once, read mostly" optical disks not technologically much different from CD-ROMs. Besides, one had to encourage young cinematographers.

When a pathway opened temporarily from Hodgkins Enterprises through Trans-America Railways to the public phone system in Casper, Wyoming, the predator had no idea of where that route would take it.

Except beyond the tightening cordon.

The military transport sped, engines droning, through stygian skies. AJ extinguished the overhead reading light, thankful that the woman at his side had fallen asleep. He needed Bev's support but couldn't take any more nervous small talk. Above all, he could bear no more undeserved sympathy.

An orderly appeared in the VIP lounge with a coffee carafe. Go away, damn it, AJ thought. An apparent mind reader, the young man slipped back through the curtain. Coffee wouldn't help. Sleep wouldn't help, either. It could only bring him dreams.

Guilty dreams.

No one had died in the destruction of the Physics Building, but that was the last miracle. Forty-one dead in traffic accidents, including twenty-two kids on a church bus for a weekend retreat. Three hundred-some dead in an air-traffic-control disaster. Twenty-eight dead in the riots, with the toll climbing hourly. AJ couldn't begin to imagine the longer-term toll from the destruction of property both tangible and intangible. What did it mean to shut down the West Coast?

He squirmed uneasily in his chair, his rear end paralyzed, trying not to disturb Bev. He recoiled as though from a flame when his shoe accidentally brushed the satchel on the deck. The package contained hardcopy and backup tapes of the experiment.

An experiment gone awry.

Something was wreaking mayhem across California. Somewhere in his satchel was a copy of *it*, or of its recent ancestors, anyway. The polite but insistent Army captain who'd come for him, who'd now graciously retreated to the back of the jet to leave them in peace, had been told that AJ should bring all available information. Now. AJ had scarcely been given enough time to pack the canvas bag and arrange for a neighbor to look in on his daughters.

He'd refused to come without Bev.

"Don't blame yourself," Bev had said. "You didn't let it loose." No, thought AJ, but I created it. I designed lab containment that was not up to the task. A virus got into *my* lab, apparently goading the thing that evolved in my experiment into its current attacks.

Hundreds dead and billions in damage. A monster on the prowl. Don't blame yourself.

There was no one else *to* blame.

The ability to learn from experience is a survival characteristic. Quick reflexes are another. The predator had some of the former trait and an abundance of the latter.

It processed the recent experiences of attack and counterattack, of confinement and escape, of its total failure to discover the unseen Power, of repeated near extinction. It learned. It reacted.

It laid low.

It cruised the nearly unbounded network, blessed with an advantage never before enjoyed by a predator: ultimately, it had no need to attack. The programs all around it had the most curious and structured simplicity, so it had only the most minimal need to compete for resources. Ever more millions of computers beckoned to it, their still unsampled presence made known by the predator's examination of every Internet directory that it encountered.

It explored. It learned. It began to experience serenity through the peaceful acquisition of knowledge.

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It was not given the time to discover wisdom.

Inoculation of the national network was swift and simple.

Inoculation took the form of phages, custom-crafted modules of software whose only purpose was to seek out and destroy any and all copies of AJ's escaped creatures. Initialized with code snippets from the experiment's backup tapes, the phages would, in theory, recognize and attack only recent-generation maze runners.

Pittman dubbed his tiny creations silver bullets. Glenn Adams likened the counterattackers to smart bombs. AJ wrung his hands and called the phages useless.

AJ was right.

Dissecting its new assailants, the predator learned something of paramount importance: the creatures were tailored specifically to attack *it*. The predator had no concept of a bloodhound, but there was no mistaking the scraps of its own software that the phages used to recognize their prey. To recognize *it*.

It could learn. It could react.

If even a quiet existence without offense could not convince the predator's curiously slow-acting Opponent to leave it alone, its course was clear.

The predator would attack, and attack, and attack again. It would devastate and destroy for as long as it took to flush out its Adversary from wherever it hid in the vast network.

Whatever resources the unseen Foe most valued, most closely guarded—these were what the predator would attack.

AJ sat staring at a blank screen.

Bev had turned off the TV, but the pictures and sounds kept replaying in his mind. *Floodgates gaping. The engineer sobbing at the dam, body racked by shudders, babbling of controls and backups and fail-safes that had somehow all refused to work. Torrents gushing through the sluices. The towering wall of water, viewed from an Eyewitness News helicopter.*

The town of Corningham, from the same perspective, as the wall of water approaches. Sirens wailing, people running to their cars only to be trapped in what must be the only traffic jam the sleepy county seat has ever seen. The wall of water breaking over everything. The stunned silence of a normally glib newscaster struck speechless as everything—people, cars and trucks, buildings, trees—is swept away irresistibly by the deluge. Bodies bobbing obscenely in the rushing waters, limbs twisted and bent.

The silent TV now spared AJ of the guilt, at least temporarily, for the other disasters being reported: a factory explosion in Chicago, tons of molten steel spilled in a Pittsburgh mill, a commuter-train collision near Omaha.

He also failed to hear that, with little fanfare, the nations of the world were severing all electronic ties with the United States.

CHAPTER 11

Pages flipped at a rate achievable only by a bored child. The book closed with a slam. "Can I hear the radio?" asked a petulant voice from the back seat.

Doug cocked his head and listened carefully. "I don't think so, Hon. It isn't on." He fancied that he could hear Carla shaking her head in disbelief.

Dramatic, long suffering sigh. "*May* I hear the radio, please? 101.7 FM?"

Probable call letters: WPUK. He suppressed his own lament and glanced at his front seatmate. Cheryl shrugged: your car, you decide. Chicken.

How bad could five minutes of—what? heavy metal?—be? He switched all the sound to the rear speakers before tapping ON and tuning in her station. "I'm glad the kid's feeling better. You're

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sure she's up to staying with your friend?"

"Getting cold feet?"

And sweaty palm. "Nah." Long silence. "Light on repartee, perhaps." More silence; time flies when you're having fun. What was his problem? Say something. "You knew that I grew up in Wisconsin, right?"

"You never mentioned it." She turned toward him. "Where?"

"Would you believe suburban Appleton?" Something like the clanging of garbage-can lids intruded from the back speakers; at least it mostly obscured the antisocial lyrics. "Dad tied flies for a living. Really exotic things. He sold a zillion to the tourists every summer."

"They must've been good."

"That's the funny part." He grinned. "Not one of Dad's flies was ever known to catch a fish. They just *looked* great. Flies are like haute cuisine, Dad always said. 'Presentation is everything.'"

"But the fish didn't like the presentation."

"The fish weren't the buyers."

Then reality intruded, diverting Cheryl into reciting directions through the neighborhood where her friend lived.

He stayed in the car while she dropped off Carla. Whether it was Milwaukee or Appleton, Dad was quite the marketer, all right, even if Doug had been fifteen before he discovered that Dad had once been Director of Marketing for Milwaukee's biggest ad agency. Life in the boonies couldn't take that marketing acumen away from him.

Couldn't remove the stress, either. Dad had died of a heart attack at age forty-one, three days before Doug turned twelve.

Turning the small talk to Cheryl's childhood—she was that true rarity, a native northern Virginian—Doug got them safely to BioSciCorp. The prosthesis-training sessions for which the VR courts had been installed might have ended—but the courts remained, still free if you had building access. It pained Doug that he had to be signed in as Cheryl's guest. He paused outside the locker rooms. "Meet you in court two."

" 'Huh,' she responded, wittily."

Doug had to laugh. "Humor me." He understood her confusion: virtual racquetball was typically played between two people in separate courts.

Cheryl was already on the court when he arrived. He'd been delayed by a detour, new game disk in hand, to the VR control room. She'd changed into a super-baggy shirt and, when he looked closely, white shorts that peeked out from underneath. Her normally wavy brown hair was pulled back into a ponytail by a bright blue scarf. Her VR goggles were already on, covering hazel eyes whose striking beauty he'd been too shy ever to comment upon.

The shirt seemed to be a high-school varsity jersey. Doug took an instant dislike to Number 10, whoever he'd been. She had no brothers.

"Take a picture. It'll last longer."

You worked together for months, he chastised himself. What's your problem? The problem, idiot, is that this isn't work. "Sorry."

Was it only him, or was the air between them crackling?

"Well?"

It made Doug no less uncomfortable that she was smiling. "Show time."

The hidden computer took its cue instantly. Cheryl needed only slightly longer to spot his surprise. "Doubles. This is *great!*"

He slipped on his own goggles. The wand in his prosthetic hand became a proper racquet. The room doubled in size. Two stylized opponents stood in the opposite court; as ceremonial bad guys, they wore eye patches and backward black baseball caps. Doug took his side of their court. "Volley for serve."

Pop. Doug blasted the red pseudoball when it materialized. Zip. Zap. Zip. *Blat.* "And the forces of evil win first serve."

After a few near collisions, Doug and

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Cheryl settled into a frontcourt/backcourt style of play. The new positions reduced their interference but did nothing for their score.

Blat.

"What handicap level did you give us?" she panted after a long, but ultimately losing, volley. Her forehead glistened with sweat.

"Gimp and simp. I guess I was too kind."

Her hazel eyes hidden by VR goggles, the smile seemed incomplete. Warm, but incomplete. "Eyes front, partner." Too late. The ball shot past him to land at his heels. *Blat.* One of the stylized figures did a little victory dance in honor of his aced serve.

Mutter, mutter. "Handicap level four." That was two notches easier than where he'd started them, and, hopefully, a level at which they could compete. They managed some decent volleys, and Cheryl slammed a return through a floating drop-dead zone to finally get them a chance to serve. The score had improved from seven-zip to three-nine when they collided at midcourt.

No one was hurt, but. . . . As he climbed to his feet, Doug felt like he'd been thrown by an electric shock. He extended an arm to help her up; her hand was hot. Both VR wands lay abandoned on the floor. "You okay?"

Somehow, their goggles had slid back on their heads, and they stared at each other. The air was thick with pheromones. *Move*, he told himself, to no effect. Then he knew he'd waited too long, and he released her hand. She waited a moment, then pivoted slowly, with apparent reluctance, toward the front of the court.

The scarf had slipped partway down her ponytail. Ah, the hell with it, he thought, and tugged a dangling end of the scarf. The bow untied, freeing cascades of flowing hair.

Evidently he'd thought out loud.

She turned back towards him, eyes glowing. "Not how I'd have phrased it, but it'll do."

For a time, neither of them had any use for words or virtuality.

The knock was so soft Cheryl thought at first that she'd imagined it. She doubted she would have noticed anything had not Doug a moment earlier inexplicably relaxed his embrace.

Then, realizing her disheveled state, she somehow knew the sound was real. She craned her neck slightly and saw the pale oval at the door's small inset window. The next rap was louder. "We have company." She pushed away a hand.

"I know." He released her and went to open the court door.

The weekend guard stood outside, leering, a radio in his hand. "Better you were doing what you were."

She resisted the urge to smooth her jersey. Her imagination was already previewing next week's office gossip. Damn, damn, *damn*. "Better than what?"

He jiggled the radio. "Than computer gaming. Than anything using a computer." He turned on the radio.

She needed only a few moments of the newsbreak to forget her own situation.

The page was from Ralph Pittman. Doug was tapping redial on his car phone for the twentieth time when Cheryl emerged from BioSciCorp. Of course, half of the country was trying to contact the forum at this point. The other half had no communications.

"How did you know?" Cheryl slid into the passenger seat. Her hair was still damp.

"What do you mean? He knew *exactly* what she meant . . . he just hoped to avoid this discussion.

"You were facing away from the door, and"—she blushed—"somewhat occupied. Yet you knew something was up *before* the guard knocked. How?"

"Pager." Keep it simple, Doug. She won't want to hear this.

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"You weren't wearing a pager." She reddened again. "Unless . . . it was in your arm." She smacked the dashboard in frustration. "It's one thing to use the arm unmodified. It's entirely different to put yourself at risk. There's a *reason* neural-interface research was suspended, why you're at the forum for now."

"Speaking of which, I still can't reach the office. Let's try something else."

Pittman answered his personal cell phone on the fourth ring. "Catastrophe central."

"Ralph, Doug Carey returning your page. You've tried phages?"

"We set out cheese. *Yes*, we tried phages."

No need to name the phages' target. The radio, its volume turned low, spoke of nothing but the artificial-life creature, or creatures, wreaking Internet havoc.

"What's plan B?" injected Cheryl.

"You'll have to ask the boss that."

Doug leaned toward the speakerphone. "The switchboard is jammed. Is he there?"

"He just left, but I can't say to where. I'll call you back."

Despite the tightness in his chest, Doug forced himself to speak calmly. "Tell Glenn that I know the one way of stopping whatever's out there."

Pittman rang back within minutes.

"You've got an invitation. It's a classified facility, though. Gimme thirty minutes and I'll be by to escort you."

Doug had a flash of intuition. "I'm picturing a squat, windowless, brown brick building here in Reston. No signs on it. Surrounded, practically hidden, by tall pines. Big rooftop dishes. I've never met anyone who admits to working there."

"What*ever* are you thinking of?"

Confirmation enough—the worst-kept secret in northern Virginia was that the unlabeled building was CIA. "Call ahead for us. If we're not in BioSciCorp's parking lot when you arrive, we've figured it out. Then meet us there."

"Okay."

Doug had it right. Dour armed guards kept them standing in the vestibule until Adams emerged to vouch for them. It wasn't much of a wait, but it was long enough to reach a conclusion. "You've been holding out on me, Glenn."

As red flashers signaled the presence of uncleared personnel, Adams shepherded them down a hallway painted in institutional gray. "How so?"

"All hell is breaking loose. You'd need a damned good reason to leave the forum. To visit what I assume is a CIA facility. I bet this is where Sheila Brunner worked, and that her research was far more relevant to cyberdefense than mind-controlled weapons systems."

"You didn't need to know then what she was doing. Do you now?" Adams gestured at an open door.

Doug hung back. "Since phages can't kill this thing, you'll be sending people into the net after it, through neural interfaces. You must be here to coordinate the attack.

"There aren't many people in this field." Fewer still after the Frankenfools and No Nukes viruses erased some minds. "Cheryl and I are two of the best. If we're to help, you'll have to tell us what's going on."

AJ sat rocking in a corner, mere spectator in the drama, the tragedy, that he'd crafted. Everyone else sat at the big conference table: Adams and Pittman from the forum, a gaggle of CIA folk, even Bev. AJ remembered that she was a reporter. He wondered if anyone else did.

He didn't feel alone in his corner: the shades of his victims crowded all around him. Most were waterlogged and battered featureless from their time in the flood. Here and there among the drowning victims jostled a few corpses who had been more conventionally mangled. Some had died in car crashes, or by plane wreck, or in civil violence. All watched him accusingly. They were more real to AJ than the breathers around the table.

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Two newcomers, Doug something and Cheryl Stern, had arrived late and joined the meeting. A CIA guy whispered to AJ why these two were here, but AJ hadn't caught it: the voiceless ones were too distracting. Eventually, AJ gave up the attempt to listen.

When he was ten, AJ had been terrified by the movie *Night of the Living Dead*. He'd lain awake all that night, eyes round, unable to imagine anything more horrible. He had learned—had it been only hours ago?—how his youthful imagination had failed him. Knowing himself for the cause of these many deaths made these zombies that much worse.

Still, snippets of conversation penetrated the fog of exhaustion and guilt.

Pittman: "Look, we had AJ's complete code for this thing. At least we have to assume that it's nearly complete. Of *course* phages found the creature. What they couldn't do, obviously, was survive the encounter. Our phages need to be nastier."

Later, Pittman again: "I still say we should release tailored copies of AJ's monster. They'll kill what's out there and each other. If one of ours is the last, it'll have a working self-destruct timer."

AJ's monster: the phrase twisted his guts. No! his mind shrieked. No! Don't release any more. I can't bear more deaths—but no words issued from his mouth. He sobbed in relief when Pittman's plan was rejected as too dangerous. Not even Bev noticed.

The voices kept talking.

Adams: "Then a reconnoiter with helmets is possible?"

He felt absurdly appreciative when Bev turned briefly to check on him. He forced himself to smile back, and tried to listen. If only the dead wouldn't crowd him so.

One of the CIA agents: "I say it's settled. We can't know if it'll work without trying. How many helmets are there?"

Helmets again. What had helmets to do with anything? A telephone lineman leered contemptuously at AJ, mockingly tapping his hard hat. Drops of water rolled down his neck.

No! He had to understand. He had to. The zombies faded somewhat when he concentrated. What were these helmets? What did the agents want to try?

With great effort, AJ began following the debate; understanding only deepened his dread. There was a way to project minds onto the data plane. They meant to hunt the monster in its lair!

A mere computer virus had already scrambled the brains of previous explorers, colleagues of Doug and Cheryl, AJ inferred. What reaction did these brave fools expect from a predator bred to that world?

Yelling erupted around the table and within his phantasmagoric entourage. What was happening? The living fools were arguing not about *if* to go, but *who* would go. Voices that only he heard shouted too, and their demands were plain: no more should join them.

With the latter's advice AJ agreed. He could bear no more deaths on his conscience. But what should he *do?* He was too muddled, too exhausted, to argue his case. He would babble, he knew, not express himself coherently.

To that thought, as well, the walking dead had an answer. If he could not speak, then he must act.

The room with the computer equipment, with the mysterious helmets, was evidently just next door. That much had become plain in the debate.

As the argument continued to rage, no one noticed AJ slip from the room.

The lab network was protected by the most foolproof of authentication mechanisms: a retinal scanner. The pattern of blood vessels in the eye is as individual as fingerprints and much harder to duplicate.

The best security equipment does no good, however, when the human element fails.

AJ didn't know what he'd find in the

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adjoining lab—he'd just heard of it, after all. He had no concrete idea what to do when he got there. He'd imagined, vaguely, that he'd somehow sweet-talk someone into logging him onto the system with a helmet. After that, AJ assumed, he'd explore. It wasn't much of a plan but, weary and guilt-ridden, it was all he could manage.

It turned out he didn't need a plan. He found an unoccupied lab and a workstation left logged on by a technician tired of waiting for the talking to end who'd popped down the hall for coffee. A helmet sat beside the clearly active workstation. The black helmet brought to mind, absurdly, thoughts of the Kaiser, its spike doubtless an omnidirectional antenna for radio linking with the computer.

AJ didn't understand what an egregious violation of security policy the unattended but active workstation was. He had no way, either, to anticipate that the careless technician would be delayed in the break room by a chance conversation. His opportunity might be only seconds long.

AJ immediately slipped on the helmet.

The predator cruised along the great data highways. Here, it sampled a great information repository; there it injected false data. Everywhere, it left behind a trail of devastation. Nothing threatened the creature but more of the incompetent, monomaniacal hunters that had so enraged it. These it easily evaded or demolished.

Where was the Opponent? the predator wondered.

Just as the predator learned the structure of mazes from its travels, it could also draw inferences from other data. It had attacked and attacked to draw forth the Foe. That strategy had failed, it concluded, and it paused its assaults while formulating a new plan. This vast network into which it had so recently escaped was now its home. Not knowing how to reverse the damage that it had already inflicted, it dared not keep destroying.

Life responds to inbred imperatives. Biological life strives above all else to survive: to defend itself, to eat, to reproduce. The predator had outlasted all of its natural competitors, its peers in the labyrinth. Its new adversary was nowhere to be found. It had no need to eat. It could not reproduce.

If only for a lack of alternatives, the primordial search for *goal* reasserted itself . . . but what was its goal now?

As it randomly prowled the data plane and explored thousands of computers, searching for it knew not what, it came to a startling realization: *There is none here like me*. Every program that it examined, every database that it inspected, was crude in construction. All were single-minded of purpose, simple of form, fragile. They uniformly lacked the richness and complexity of its structure. None compared to its inherited memories of its ancestors.

What the predator could not conceptualize was simply this: in a world of artifacts, it alone bore the scars and random brilliance of mutation. It alone had evolved. It alone was *alive*.

It was thus with an indescribable sense of relief that the creature at long last detected unfamiliar ripples in the network. Ripples suggestive of something much like itself. Something living.

Scant microseconds after its discovery, the predator was on its way to the source of those tantalizing signals.

Sensations without names flooded AJ's consciousness. He felt sounds of swirling colors; smelled strange and wondrous shapes; beheld images of stunning tartness. Crashing chords of vibrant light seized and shook him.

Perceptions alien beyond even total sensory contradiction hammered his mind. Stimuli advanced and receded in an ever-varying number of nameless directions, in dimensions unimaginable in number and kind. Each transient dimen-

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sion brought with it a new component of vertigo.

From the maelstrom of insanity, some iron-willed fragment of AJ's consciousness rebelled. Somewhere, insisted that inner voice, synapses are firing. No more, no less. Your brain simply lacks a useful categorization for the unaccustomed neural excitations from the helmet. Whatever concept came closest to a foreign perception, that was the label a confused hindbrain attempted to place on it. Why, demanded that voice of reason, should immersion in the data plane reveal information familiar to an evolved piece of meat?

Why indeed?

The sensory onslaught receded before the counterattack of logic. Unimaginable stimuli remained, but they became separate from him: phenomena to be evaluated; curiosities, not threats. Calmer now, AJ began to interpret the new data. Objectivity replaced hysteria. What, he challenged himself, do you know about your environment?

Order began emerging from chaos. Part of the improvement, unbeknownst to AJ, came from the automatic adjustment to him of the helmet's neural net, adaptation that had been delayed by his panic. The tide of sensations resolved itself into . . . sounds? feelings? smells?

No, he decided, they were *lights*. Humans are intensely visual beings, so let the stimuli be visual. A baby's ability to instantly recognize a face took, he knew, massive computing power to emulate. Neurons and synapses were individually slow, but a human brain held a myriad of both.

Reacting to his thoughts, the helmet redirected stimuli to his visual cortex. The flood of information transmuted into a picture. The image remained incomprehensible until his mind wrestled it, too, into a frame of reference. Strange forms surrounded him: pulsating, twining tendrils, trading pellets. The forms had shape and size, texture and color—visual attributes with which his mind could work effectively. It began to do so.

He was a computer scientist within a computer. Outside that computer, scant seconds had passed . . . but in those few seconds, beset by the rush of sensations, he'd lost his balance. So complete was the helmet-mediated immersion that he had not immediately recognized pain. He'd stumbled against a lab bench and pinched his side. The ribs felt bruised.

Those shapes? What were they? AJ groped until he found a chair and sat blindly. He'd anticipated—what? Computer memory: bits and bytes. Wires. Integrated circuits. That was silly, really, like expecting to see atoms and molecules with his naked eyes. The helmet revealed a higher level of virtuality. AJ was witnessing, he decided, the execution of whole programs, the exchange of control messages between them, the influx and outflow of information. The vista before him, so recently threatening, transformed into a pastoral scene, somewhere between prairie grass blowing in a breeze and seaweed swaying amid underwater currents. The pellets moving between the larger shapes, AJ decided, were the idyllic meditations of gentle vegetation.

Focusing on one undulating form, he gasped with delight as he somehow projected a mental probe at that object. Awareness rushed at him through his extrusion: the target program's purpose, its execution status, its instantaneous demand for computing resources. Experimentally, he withdrew the probe; the insight stopped.

More deliberately, he reached for another program. The examined shape magnified, expanded into a twinkling swarm of lights. As AJ mastered the helmet, the once overwhelming flow of information resolved itself into an elegant graphical representation of the state of the program and its symbiosis with the computer. It was beautiful.

But beauty would not find and slay the creature. His creature. AJ forced his mind back to the task at hand. His atten-

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tion turned to a program his subconscious had represented as a red octagon. He had somehow, until now, failed to associate that configuration with a stop sign. To and from the octagon flowed an endless rainbow of pellets. Messages. This was the way out.

His consciousness slipped into the octagon. A pull here; a shove there. In an instant, a pathway was unlocked to the Internet. He expected to find a deeper stream of message packets, glimpses of other program/shapes, passages to more computers. All of these he found.

He also discovered, waiting for him on an adjacent node of the network, a scintillating, coruscating, betentacled horror beyond all imagining.

CHAPTER 12

"Industrial espionage," said Doug in disgust. His eyes bored into Adams'.

"No one said that. Yes, the Agency's helmets let analysts navigate the data plane and investigate computers. You don't need to know whose machines have been visited. Or why."

Doug ignored the nondenial. "With viruses like Frankenfools on the loose, no one dared use the helmets. Could've been an eco-nut behind them; could've been a brilliant counterintelligence riposte. No wonder the FBI came running when I asked at the forum about Sheila Brunner."

Adams merely shrugged.

He felt like a fool when the insight hit. "You never expected quarantining viruses to work, or at least you didn't much care. It was just a way to divert me from my research. Once you had my approach for making neural interfaces safe, a way to restart the CIA's neural-interface effort, you did your subtle best to slow down my own development: 'test thoroughly,' you said. The longer my unclassified work took, the more discredited neural interfacing became." Doug pounded the table. "You used my ideas without my knowledge, while doing all you could to slow me down."

"You didn't have a need to know."

It was a justification that left Doug momentarily speechless.

Cheryl looked from face to face in despair. Arguing did nothing to stop the thing that AJ had created. Talking couldn't help AJ, either. She turned around for a quick check on the remorseful scientist.

He wasn't there.

She'd just opened her mouth to raise an alarm when a bloodcurdling shriek beat her to it.

The curious ripples in the data plane strengthened as the predator, moving across the continent on speed-of-light microwave transmissions, neared the unknown signal's source. Hints of depth, of evolutionary richness, titillated it. This signal came from no simple artifact, no primitive program such as the myriads that littered the network. *This* modulation of the data plane denoted the presence of a complex being much like itself.

But was this other its long-sought Adversary?

The predator halted at a computing node near the apparent origin of the signals. At such close proximity, great textured waves of information inundated it.

It pondered. Might the being on the other side of the security gateway indeed be like itself?

There seemed only one way to find out.

The data that impelled its introspection were indirect, were clearly leakage from behind what the predator recognized as a security gateway. Delaying only to reassure itself that it had sufficient avenues of retreat, it studied the locked portal. Once before, cornered by viruses and threatened by imminent loss of power, it had solved the problem of such a barrier. Doing so again, without such dangers, would be easy.

It had just set out to penetrate the security gateway when, unexpectedly, the

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obstacle vanished. Waves of cognition gushed through the portal and enveloped the predator.

For a moment, the predator basked in the novelty of the sensation. The newfound sentience it confronted was richly replicated, massively parallel in its processing, well endowed with the false starts and radical departures that characterized the evolved mind. This was, truly, a being much like itself—in many ways, greater than itself. For an instant, the predator sensed that its isolation was over.

But only for an instant.

The nexus of cognition before it recoiled. The suddenly contracting wave of information was unlike anything that the predator had ever encountered. The flinching data constructs were malformed, incomplete, illogical.

While the entity had on several occasions experienced fear, that sensation had been honestly acquired under conditions of mortal peril. Never had its reactions been hormonal and reflexive. Now, wave after wave of unfamiliar passion washed over it: disgust, loathing, hatred.

A second reaction followed closely behind the stranger's first. Questing pseudopodia thrust forward. Were the tentacles meant to attack the predator or to fend it off? It did not, could not, know.

It took no chances.

With many times the speed and grace of a cobra, the predator struck back. Evading the oncoming limbs, it plunged its own projections far into its attacker.

And as the predator tore those lovely, rich structures of data and logic into random bits, it drank deeply, as it always did, of its opponent's knowledge. Even in its weakened state, the Adversary, for such this creature clearly was, provided information of unprecedented value and complexity.

Vital information.

There were other Adversaries, the predator learned. Their massed attack was imminent.

Guards with drawn pistols reached the lab seconds before the people from the interrupted strategy session. Crowding into the small room, the latecomers found themselves confronted by the same dilemma as the security team: should they remove the helmet from the bellowing, convulsing figure before them? It might save him, or it could irrevocably sever the tenuous connection to a mind projected out somewhere into the network.

Screaming herself now, Bev shoved at the men standing between her and her lover. Doug and Glenn Adams held her back, their differences of a moment ago forgotten. "Quiet!" hissed Adams. "Let us think."

The writhing figure arched its back so violently that it fell from the chair. The snug-fitting helmet flew off. White eyes turned far back into his head rolled slowly forward. Blood-tinged drool trickled from a corner of his mouth.

Bev twisted free and rushed to her lover. She dropped to the floor, then gently lifted his head and cradled it on her lap. "Hold on, AJ. Help is coming."

He smiled weakly. "Remember to write about survival of the fittest."

His body shuddered once more, and was still.

CHAPTER 13

Shapes of countless hues and sizes jostled one another, the figures swelling and shrinking dynamically with their instantaneous memory requirements. Splashes of color shot between executing software processes, each a packet of information. Some data exchanges were so rapid that the interprocess traffic blurred into a virtual stream.

Weird, thought Ralph Pittman. He reached up to adjust the oversized helmet covering his eyes and ears. Each shape, he knew, was an independent program. The CIA trainer had suggested taking a few moments to conceptualize,

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to will the scene into a comfortable format, before attempting to interact with anything. The helmet, the trainer had explained, would help.

Let there be right angles. At Ralph's mental direction, the shapes quickly melted into boxes. The data streams continued unabated. With program shapes more easily visualized, Pittman now noticed intertwined tendrils between them. The writhing forms were busiest, almost obscenely so, around the largest box. His mind had colored that unit a dark blue. What was that thing? Why was it TV-standard, police uniform blue?

Traffic cop! In other words, the OS. The operating system was the supervisor of all resources in the computer. Pittman "looked" at himself, and saw yet another box. He was pink, with tendrils entwined with the operating system's: requests for, and grants of, system services.

How long had he been at this? *Yo, OS, what's the time?* His thought materialized as another tendril, a call to the timekeeping service. 21:08:13.845, came the reply. A little after nine P.M. He'd donned the black neural-interface helmet at—what?—9:07 this evening. Not bad.

Practice seemed to be making perfect. Unlike that poor dumb bastard, AJ, he and his co-explorers were practicing with the gateway powered off. Whatever was out there would have to wait to have at him.

"How's it look, Ralph?" Glenn Adam's voice crackled in Pittman's ears. Figures: the helmet embodied technology that must've cost many millions to develop, and it used buck ninety-eight earphones.

"Tense, man."

"What's wrong?" demanded Adams anxiously.

To a hacker, "tense" means tight and efficient: it's a good thing. Pittman suppressed a sigh. "Relax, boss. It's a figure of speech."

As he spoke, Ralph extended more thoughts at the operating system. It responded with the date and the first of a series of every-ten-seconds wakeup calls. *Inside*, as he'd begun to think of his surroundings, ten seconds was a long time.

Each type of system call, he noticed with interest, had a slightly different shape—which meant they made up a sign language. The system calls made by a program denoted the pattern of services it required, which was characteristic of the tasks that the program performed.

Ding!

Wakeup call. "No one here but us chickens." The outside hopefully propitiated, he returned his attention to the amazing vistas before him. Using the newfound sign language, he speedily deduced the purposes of his neighbors. Here, making repeated calls to the directory service, was an email program. There, throwing off packets like a Fourth of July sparkler, was what had to be a DBMS, a database management system, answering queries. He identified, at least to his own satisfaction, an accounting package, a report generator, and the control program for the helmet itself. That, Pittman told himself sternly, you stay the hell away from.

Ding!

"Cluck cluck." Electric blue flashes sped to and from the helmet's control program. He followed a similar stream from the control program to its terminus: a splotchy block that he hadn't noticed before. Camouflage? A fellow explorer, perhaps. Cautiously, Pittman extended a tendril towards it. *Who's there?* he prepared to ask.

Another tendril shot out to parry his own. The tentacle encircled his, gave it a healthy twist, then withdrew warily. Pain shot up Pittman's tentacle. "Ow!" That jolt might have been imagined, pure power of suggestion, but AJ's experience proved you *could* get hurt in here.

"What is it?" The crackled interrogatory was anxious.

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"Nothing. I'm fine."

His companions had also heard the question. "Boys will be boys." The laconic comment came up under the helmet, not through it. Pittman recognized the senior CIA agent: Bob Tyler.

Ding! He ignored this tone, having just spoken. Who? he asked the OS, which obligingly returned the list of logged-on users. The list included the four agents and himself.

He reached out to the email program.

TO: BTYLER
FROM: PITTMAN
SUBJECT: SORRY
I'LL BE GOOD. KISS KISS. HUG HUG.

He followed the message packet first to the email program and then to the "agent." CUTE, read the reply.

The initial text exchange might have been frivolous, but the resulting communications channel wasn't. Through a flurry of email messages, the explorers negotiated direct links for speed-of-thought communications. It was the next best thing to telepathy. Their explorations now effortlessly coordinated, they quickly surveyed the strange environment.

Ding!

"No signs of a chicken hawk. Can we go outside?" Beneath the helmet came the muffled sounds of his companions' agreement. "We promise to play nice."

Inside, spoken words were painfully slow. The incredible world all around revealed ever more detail as he acclimated, his subconscious adding nuance with every free association.

Hacker to the core, Pittman *had* to try breaking into the OS. As the operating system kept thwarting him, its original stark boxiness grew crenellations and turrets; its initial blueness faded into gray. He practically shouted for joy as the "castle" walls became rough and stony.

"We'll power up the gateway, but stay inside."

"Hmm." In the seeming distance, Pittman felt the pressure of the deadman switch in his right hand. He tightened his grip. No one knew what would happen if he were to release with his mind projected. Things would be damned hopeless before he'd attempt *that* experiment.

Four camouflaged shapes moved into formation around Pittman. He didn't know how many dimensions existed in this "space," or if the concept of dimension had meaning outside his subconscious attempt to impose structure on chaos. Either way, he saw himself at the center of a tetrahedron. The pattern provided at best limited protection—the OS, for example, continued to have access to him right past his would-be protectors—but the CIA owned only five prototype helmets. One forum expert and four bodyguards were *it*. If they couldn't repulse whatever was haunting the Internet, the US would have to revert to a Fifties economy.

"Five movin' out," called Tyler. The agent's words were aloud, so Pittman ignored yet another wakeup call.

The hacker tried to will "his" box into camouflage, but his mind was as militantly pacifistic as ever: he remained pink. Skin pink, he decided. Bare-assed naked pink. To his amusement, as if in response to this thought, his box melted into a more-or-less human figure. It was undressed. His guards remained camouflaged, but, within uniforms, also morphed to human shape. Cautiously, the homunculi advanced, whatever that verb implied here, across the data plane.

A long tunnel suddenly gaped before them. What his endlessly inventive subconscious pictured as a massive wooden portcullis blocked the other end of the passageway. Lights twinkled through the grating. Each "star" was another computer, a distant locus of colored processes and data packets like the myriads shining all around them.

Beyond the portcullis—the lab's security gateway—a new universe beckoned.

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* * *

Apart from its formidable defenses, the gateway offered little of interest. Well before the first *ding!* followed him into the pipe, Ralph Pittman was bored with the simpleminded, special-purpose computer. "Everything's in order, Colonel. Open up."

"Let's go a little slower, Ralph."

Operating at the speed of meat, there was no telling when Adams might relent. Pittman shot an electronic query to Tyler. GO FOR IT?

IF YOU KNOW HOW, came right back.

The agents, Pittman had noticed, were field men with little interest in taking orders from a regular Army puke. Ex-Army at that. The naked homunculus grinned. Examining what he'd visualized as a fortress, he found time to think: hope it's only me who sees me like this.

Like any new computer, the gateway had been shipped by its manufacturer with a preprogrammed account name and password. The built-in account had "superuser" privileges for the installer's convenience. The new owner's first order of business should be to change that password. In point of fact, the superuser password *had* been changed on the computer that directly controlled the helmets. Pittman had confirmed that early on.

Not so on the gateway.

Pittman knew the default password: he'd installed two similar gateways in the forum's laboratories. He'd suspected that AJ, to his misfortune, had also known the installation password. With a mental thumbs up to his companions, the hacker projected the password to the portcullis.

With the impressive clanking of imagined chains, the portcullis began to rise.

Ages passed.

The predator had long since processed, to the extent it was able, the information stolen from the dead Adversary. Much of what it had taken made no sense. Many of the data structures related to concepts—trees, for example, and bank accounts, and deodorant commercials—for which the creature simply lacked any referent. Other data were seemingly contaminated by emotion, what the predator experienced as dangerous illogic.

Still, it absorbed what it could. That had included the assurances that more beings like the Adversary would come. Would hunt it down. For ages, as it continued to roam the network, the predator waited.

And waited.

Not long after the predator concluded that the predicted new assailants were yet another form of emotional delusion, new sets of ripples began to emanate from the node where it had encountered its Adversary. Where one opponent had been vanquished, five now appeared.

It was ready.

Distracted by Pittman's subversion of the security gateway, three of the four operatives did not immediately notice the rapid approach of a nearby sparkle. Tyler, the team leader and point man of the advance, *did* notice, only to be undone by old habits.

Astronomy had always fascinated the senior agent. He'd spent untold nights of his youth skygazing. These sparkling lights, his subconscious mind now told him, were the stars of a vast inner space. What harm could there be in a shooting star? Tyler relaxed instinctively before professional caution reasserted itself.

However momentary, it had been a fatal lapse.

The "shooting star" approached with, indeed, meteoric velocity. With amazing speed—the gateway interfaced the lab to the Internet over a multigigabit/second optical fiber—the dimensionless point of light expanded into a visible shape. It wasn't geometric; before he had a chance to decide what his subconscious was trying to tell him, the shape was no longer approaching. It was *here*.

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It extruded beclawed tentacles that ripped him instantly to shreds.

Every mental function in excess of a carrot's was scrambled before Tyler's hand relaxed on the dead-man's switch.

The agent's scream and convulsions immediately alerted the observers in the lab. Forewarned by AJ's experience, Adams had a medical team on standby. Most swarmed around Tyler; two remained on duty beside Pittman. Though Glenn Adams' heart went out to the fallen agent, his eyes never left a nearby computer monitor.

Classified neural-interface technology had advanced far beyond anything in the open literature. Exploiting the latest breakthroughs, the hacker's helmet was the most complex by far of the five. Exquisitely sensitive sensors lined its inside surface, each unit measuring tiny variations in the local magnetic field. Such fluctuations resulted from changes of blood flow within the brain, since oxygenated and deoxygenated hemoglobin molecules had slightly different magnetic moments. An expert could read in the pattern of oxygen-rich and oxygen-poor regions the dominant modes of brain stimulation. The BOLD—blood oxygen level detector—monitor showed active regions in red, idle regions in green, and average regions in yellow.

It did not take a neurologist to read the present display. Large portions of Pittman's cerebrum had flared blazing red, especially around the optic nerves. Was this the high-tech representation of eyes bugging out?

"What's happening?" he demanded. The red glowed brighter and brighter. "Talk!"

"It's here." Pittman was speaking before the order was complete, his voice machine-gun-fast and higher pitched than usual. "It nailed Tyler the instant that we opened the gateway. Beckwith and Brown are fighting it. It's in the building now. Dodd is trying to get behind it."

Adams shoved aside the doctor standing between him and the gateway. This was a chance not to be missed. As he lunged at the gateway's power switch, Beckwith and Brown started to scream. The toggle flipped to OFF with a satisfying *click*.

"It's trapped!" shouted Adams. "Get out *now*." As he spoke, Dodd, too, went into a seizure. Pittman's brain on the monitor glowed an unearthly crimson. "Out, out, out!"

A writhing, claw-tipped *something* passed through the brain image. Then the brain representation went black as the hacker, his dead-man's switch dropped, convulsively tore the helmet from his head. His right arm didn't move properly.

Screaming, "Get them out! Get them OUT!" Pittman threw himself across the lab bench that separated him from Dodd. The agent's hand still clutched his dead-man's switch. Pittman pried ineffectively with his left hand and right fist, breaking two of the agent's fingers without success. With a roar of frustration, he switched tactics and ripped the helmet off the agent's head.

Adams, accustomed to combat, kept his nerves under tighter control. All the helmets were radio-linked to one computer. Its power cord ran snakelike beneath the lab's central bench. He hooked a shoe tip under the cord near the plug and pulled. As the plug popped free, he took a cellular phone from his shirt pocket. "Electricity off, now," he ordered the unseen head of building security. "Whole goddamn building. Nothing goes back on until I personally walk this place room by room and make sure that every computer is turned off."

"Roger that."

The ceiling fixtures went dark, to be replaced within seconds by emergency lights. Adams relaxed slightly: he'd been assured earlier none of the computers was on an emergency circuit.

"Clear!" yelled a doctor. Dodd's back arched under the shock from a defibril-

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lator's two high-voltage paddles. The emergency equipment was battery powered. "Clear!" The scene repeated by Brown and Beckwith. The medical bustle had quietly stopped around Tyler.

Pittman shuddered, but except for the twitching arm, he seemed functional. At least Ralph could talk and act: that was a good sign.

Adams wound carefully through the crowded room. He put his arm around the quirky employee of whom he was suddenly inordinately proud. "You did it, Ralph. You and the others did it. You lured it in. We trapped it in the building, and then we killed it." With his free arm, Glenn gestured at the fallen. From the no longer frenetic pace around the agents, it was clear none of them had made it. "They didn't die in vain."

"You stupid, egotistical man." Pittman shrugged off the sympathetic arm. "*We* didn't do jackshit. That thing is faster than you can imagine. It had plenty of time, after you killed the gateway power, to reduce those brave, foolish men to mental hamburger. It was gone long before the end of the shutdown sequence.

"You might as well turn the friggin' lights back on."

CHAPTER 14

The CIA doctor hadn't been offended by Bev Greenwood's dismissal. He could always come back later with a sedative. It was better if she could work partway, no matter how little, through her grief first.

As the doctor closed the door behind him, Doug and Cheryl looked at each other and at the softly crying woman. Their hearts went out to her, of course, but they barely knew her. Neither knew what to say. First Cheryl, then Doug, sat beside her on the threadbare sofa of the borrowed office. Doug offered a hand to squeeze; Cheryl, a hankie. We're here, said the gestures. We may have just met, but we still feel some of what you do. You're not alone.

Nothing they might have spoken would have been any better received.

The sobbing gradually slowed. The tight grip on Doug's hand eased. The woman even smiled ruefully at the sodden, cosmetic-smeared handkerchief in her hand. "I . . . I think I'd like to be alone now."

Doug followed Cheryl from the room, surprised at the twinges in his left arm and shoulder. Must've pulled something supporting Bev on the way from the lab, he decided. Doug smiled encouragement he did not feel as he shut the teary-eyed woman into the inner office.

Cheryl had headed straight for a phone, and was asking softly if Carla could spend the night at her baby-sitting friend's house. "Not that kind of an evening, Barb," she answered an unheard, but obvious, question.

No, not that kind of an evening at all. Doug was about to suggest that he drop her off, sure that neither the CIA nor the forum planned any further action tonight, when somewhere in the building screaming started.

Then all of the lights went off.

Expressions around the conference table were uniformly grim. AJ's death had been bad enough, but all, to some degree, had rationalized it away. He had been exhausted, wracked with guilt, an academic unaccustomed to action. The latest deaths permitted no such rationalizations.

The thing on the network had effortlessly killed four seasoned operatives. As though enraged by the encounter, the creature had begun yet another rampage. There were hundreds of disasters, of which the most visible was the spectacular crash of the Northwest regional power distribution system. Parts of four states and British Columbia would be without power for hours.

Pittman sat at the head of the table. On both sides of the table, replacements for the fallen agents studied him carefully, seeking clues to whatever lay in wait. To avenge your buddies was an obliga-

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tion of duty and honor. To leap into a nameless meat grinder was entirely different.

At the opposite end of the table, Doug and Cheryl sat silently but flashed Pittman occasional looks of encouragement. A wooden-faced Adams sat next to Cheryl.

The hacker cleared his throat. The palsy in his arm had subsided a bit, following treatment as if for a *petit mal* seizure. He took no comfort from the bland assurances of agency physicians that he'd probably recover normal function in the limb. Eventually. How the hell would they know? Pittman asked himself. Any of them ever been brainfucked by an electronic monster?

"The colonel," he nodded at his boss, "wants a debrief. Don't expect to like it, although there is *one* valuable bit of data. I paid for it," and he flapped his injured arm, "so I hope it's worth it. There was some information leakage into me when it attacked. That thing is one of a kind, as far as it knows."

"Does it have any concept of geography?" asked Doug abruptly.

What an odd question, thought Pittman. "I haven't a clue." Or did he? "Not geography, exactly, I don't believe. Proximity, sort of. Why?"

"Explain about proximity," Doug persisted.

He considered. "I sensed that it knew the time spent moving between computers, that it preferred short hops to long ones." The creature *had* to understand routing tables, to get around the Internet. It wasn't terribly surprising that its understanding encompassed transmission delays.

"That preference is logical, given what we know of its breeding." Doug's eyes narrowed in concentration. "Its ancestors for countless generations were the fastest through the mazes—otherwise they weren't chosen to reproduce. That's probably why it remained in densely networked North America long enough to get trapped, instead of jumping by satellite or undersea cable to, say, Asia or South America."

"Why?" Pittman tried again.

"Just thinking out loud. I dislike loose ends." Doug shrugged. "I didn't mean to hijack the meeting. Go on."

After recapping the disastrous mission, Pittman opened the session to discussion. The questions flew fast and furious, coming mostly from the presumptive second wave of attackers. He answered just as rapidly.

"With proper training, which the technicians will give you, yes, you acclimate quickly. In minutes, you can start moving around the data plane. The folks who designed the helmets deserved better than they got." What they'd gotten was brain-wiped, courtesy of viruses that were like baby bunnies beside what Ralph had encountered.

"I can't describe what the data plane 'looks' like. It probably doesn't have an appearance in any objective sense. Everything's so odd that your mind, abetted by your helmet, plays tricks on you. What scares me is how that subconscious editing must hide things, critical things, from view. We might've seen it faster if we'd watched with unbiased 'eyes.'"

The agents hung on each word, looking more stoic the longer he spoke. Stoic? Fatalistic.

"Fast?" He laughed, and it wasn't a pleasant sound. "I can scarcely believe how fast that thing is. Still, you should know that *we*, people, are much quicker in there, too. More precisely, brain plus helmet is quicker. The neural net within the helmet is so adaptive, it automatically learns and takes over repetitive mental chores for you—and transistors run rings around our old-fashioned neurons. The problem is, you have to handle that rate difference, master your confused reflexes. AJ's monster, on the other hand, evolved in there.

"I can no more describe its appearance than where it lives or how it strikes. I lack the words. Besides, as I

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said, your mind and helmet try to show everything, no matter how strange, as something familiar.

"For me, it was Cthulhu, that evil and unspeakable horror out of H. P. Lovecraft. If those stories hadn't made such an impression on me, maybe it would've looked different." The hacker closed his eyes, the memory somehow clearer to him by inner sight.

"Think of darkness not as the absence of light, but as something palpable. Within the blackness, picture an obscenity of ever-changing, writhing limbs tipped with every manner of claw and fang and horn. Imagine standing helpless in the unblinking gaze of an utterly alien and all-penetrating sight.

"Can't do it?"

His eyes reopened without focusing. "God knows I'll spend the rest of my life trying to forget it."

The questions petered out as it became clear the coming mission wasn't likely to kill the creature, wasn't even a credible delaying action. In the awkward silence that ensued, agents studied one another and the table unenthusiastically, each man contemplating throwing his life away for no better reason than *something had to be done.*

Still, as Pittman's narrative unfolded, Doug found himself in a strange state of excitement. It was as if everything in his life had brought him to this singular crisis. The more soft-spoken the agents had become in their questioning, the surer Doug became. Every one of these men, he thought, is a trained killer. Any one of them could destroy me in an instant. But what they can't do, and *I* can, is stop this thing. Once and for all, I can stop it. *Me.*

In the focus of the moment, he put completely from his mind the annoying tingle in his still tender left shoulder. He cleared his throat for attention.

Everyone turned towards him, the agents doing so with undisguised relief.

"I'll accept that someone can learn to conceptualize the data plane in a few minutes." Unvoiced ire accompanied that acceptance. The neural-interface technology he had worked with demanded lengthy sessions of biofeedback training. CIA scientists had exploited *Doug's* ideas to restart NIT research while others awaited forum blessing of his antivirus techniques. All the while, Adams had been stringing him along, demanding higher and higher standards of proof before a public announcement of success. Stalling Doug and trying to divert him to altogether unrelated projects. All the while, the CIA was free to spy using technology that the government publicly discredited.

Still . . . had the CIA not made these advances, they'd be defenseless. He tamped down his anger at the deception. "That lets data-plane explorers look around, poke and prod, even move about. What I don't believe, Ralph, is that such limited exposure denotes expertise."

Cheryl eyed him sharply, as if she suspected where he was going, but, in case she was wrong, had no intention of giving him any crazy ideas. He tried to not think of her. Of them.

He turned to an agent. "I can imagine hand-to-hand combat without having done it. Let's go beyond that and postulate that I've had a few days or even weeks of practice. How would I do up against you?"

Doug took the feral grin as a response. "Right. Road kill." He let that sink in for a bit before continuing. "We need someone with extensive neural-interface experience."

"The damned viruses got ev—" Adams began.

"No! You can't mean it, Doug," Cheryl cut in. "Your experience is with an arm. A neurally interfaced *arm.* You have no more helmet experience than Ralph."

Or than Ralph's four dead escorts. Five dead, counting AJ.

He reached for her hand. She jerked it

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away. "Don't do this. Don't be a hero. You'll wind up like AJ." A look of fear washed over her face. "Or Sheila Brunner."

Doug recalled that mindless victim all too well: vacant eyes in an expressionless face, a single compulsion running in an endless loop through a ruined brain. The memory clamped a band of steel around his chest. He swallowed hard. "It's not the same." Was he speaking to himself or to Cheryl?

"What I have, and no one else here, or anywhere, has, is years of practice with neural interfaces. I'm not just now learning to use them. Ask these guys," and he gestured at the watching agents, "if in the martial arts you think before each punch thrown or blow parried."

"Do you *really* want to do this, Doug?" Glenn Adams, whose eyes, minutes earlier, had held only defeat, now held a faint glimmer of hope.

"No, I don't want to. I have to."

"Are you sure?"

The eyes held something else, some other emotion, that Doug couldn't place. Then the colonel spoke again, and Doug placed it: guilt.

"I have a real problem sending in friends."

They both knew that Adams could, and would, do just that. He was an Army officer before anything else. He would do what he must and then live with the scars.

Doug looked around the room. The agents silently pleaded: if you have an edge, even the hint of one, help us. Adams did his best, which wasn't enough, to seem neutral. Pittman was drained, too weary to make a decision. No one spoke.

Cheryl refused to meet his gaze.

The silence became oppressive. "After years spent training a neurally interfaced arm, I may be the only person in the world with the right reflexes. How can I not go in?"

Doug asked for a moment alone with Cheryl. She was furious, but not quite enough to deny him. That, or even deeper feelings kept her there. Whatever her reason, she stayed as everyone else filed from the room. They expected him in the lab shortly.

"It's something I have to do." He looked down at his prosthesis. For once, the arm was a unique qualification instead of a handicap. Instead of a daily reminder of the accident that had taken Holly. "It's something I have to do," he repeated.

She stared at him, eyes brimming with tears. "What are you trying to prove?"

That Holly had not died for nothing. That it was okay he survived the accident that took her. That maybe, just maybe, he was entitled to happiness again, with Cheryl. There wasn't time for any of that. "It's something I have to do."

Heart pounding, he strode from the room.

With Ralph's coaching, Doug quickly succeeded in visualizing the data plane. His imagery was slightly different from the hacker's: boxes, too, but as soaring buildings of a mighty city. The message streams were traffic arteries of various sizes, from crowded expressways to lightly traveled local streets. Ralph's description had more closely resembled a geometric garden.

Otherwise modern, Doug's city was walled like a medieval stronghold. In the battlement's stone and mortar, Doug recognized a familiar pattern: software derived from his own attempts to protect neural interfaces from viruses. *His* code didn't allow high data rates through the interface. The CIA version had been modified to let pass user-approved—stolen?—data.

AJ's monster was far smarter than a virus. Pittman's experience made plain the thing had figured how to mimic approval. Against it, the helmet's defenses were as flimsy as tissue paper.

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Ding! Another ten seconds. Ralph had also shared the idea of a wakeup call. As the helmet's neural net learned to work with him, as it did more and more for him, successive tones seemed farther and farther apart. "Looking good," Doug called out.

The hacker's voice crackled in Doug's headset. "Tell us when to unleash the targets."

The targets were Doug's idea. Simple modifications to Ralph's standard antivirus phages, they would be his practice dummies. At Doug's signal, the first phage would be loosed.

"Release number one." After what seemed geological time, a new program popped into view. In keeping with his subconscious's metropolitan metaphor, the phage appeared as a shiny-eyed rat. What was that old movie about a kid with an attack rat? Okay, Willard number one.

Willard, in the interest of Doug's safety, had been hastily tweaked to recognize and overwrite a sacrificial accounting package. The rat sniffed for its quarry, darting from building to building. Doug "sat" back and watched. He'd already spotted Willard's intended victim: a stolid, five-story brownstone. He flexed his "muscles" as he waited, only then noticing how he'd cast himself: as a camouflaged soldier. Power of suggestion? Even here he had a prosthesis. It made sense; one-armed *was* how he thought of himself.

The artificial arm swung ominously. Gotta be careful in here, he told himself sternly.

Ding! "Little guy is still nosing around. Ugly fella." He tracked the phage as he spoke. "It'll find the accounting program any second now." A second seemed like roughly forever.

Why wait? He flicked the "prosthesis" at the "rat." Correction: red splotch. He'd been a tad vigorous: the brownstone now had a hole punched through one wall. "Oops. Don't know my own strength."

"What?"

"Never mind. Anyway, that was me who trashed the accounting program. I trust you've got a backup?" Without waiting for a response, he added, "Release number two."

Two was faster than one, by design. Three was faster than two, and four was quicker still. Doug had no problem dispatching this whole series of phages. Along the way, his targets morphed from small rat to snarling, junkyard dog. Along the way, too, discarding the military conceit, he'd willed his avatar into a more familiar form. He took a few trial swings: Doug Carey, Ninja racqueteer. The "racquet" felt natural in his "hand," which meant long-trained hand/eye reflexes, and whatever the neural wiring in him that implemented that learning, were readable by the helmet. It was the adaptation he'd counted on.

Ding! "Time for the next phase." Phase two phages didn't stalk unsuspecting programs. The next phages would respond to a keyword. Once Doug emitted a message packet containing that keyword, the phage would come after *him.*

"Wait a sec," suggested Adams. "The BOLD monitor shows you're a bit agitated."

"I wonder why." Eight . . . nine . . . ten. *Ding!* "About that phage, guys? I march to a different drummer in here."

A keyboard click released the phase-two drone. Hey dude, Doug thought at it.

The wolflike phage stiffened at the keyword "dude." It spun, ready to attack, jaws slobbering. Doug deftly smashed it. The next two fell as easily.

"You okay, Doug? Your heartbeat's way up."

It took a moment to remember he was wired to an EKG. "Yeah, yeah. Keep 'em coming." The immersion experience was so real Doug thought nothing of his shortness of breath. He was working hard, wasn't he?

"Probably only the excitement." The

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doubting voice was that of a CIA doctor. Ogawa?

"Okay, Doug," said Adams. More keystrokes. "Final phase."

A pack of phages popped all at once into the metropolis. At Doug's challenge, they pivoted *en masse* and charged. He had run out of animal analogies: these things were just hideous. Teeth and talons predominated.

"Jesus, he's fast," he heard Pittman say. The hacker was seated at a display showing status reports from the phages. "*I* couldn't move like that in there. Maybe Doug's right."

Doug laid about with the racquet that was, from hours of daily practice, an extension of his arm. Whirling and weaving like a dervish, he zigzagged through the pack and back again. As he moved, he whacked the swarming creatures like so many large and grotesque VR raquetballs. The phages were quick and mean, but fragile: one or two blows disabled any attacker.

AJ, had he been there, would have pontificated that the phages were programmed, were mere artifacts displaying that distinctively human obsession with efficiency. He would have explained that nature preferred conservatism to efficiency, that evolution kept what worked and added to it: survival through massive redundancy. Smiling ironically, no doubt, he would have said that he'd programmed the maze runners to *evolve* in that way. No, AJ's creature wouldn't be another frail, flimsy pushover.

But AJ could no longer remind anyone of anything.

"Got . . . 'em . . . all."

"You okay?" Adams sounded unhappy. What did his boss see on the med displays?

Ogawa was evidently watching the same monitors. "Calm down or. . . ." The doctor had no time to complete his threat.

Rapid footsteps approached, followed by Cheryl's voice. "I've been watching CNN. Things are grim on the Internet, and the European Union is panicking. They've already powered down every transatlantic link from their side. If the disasters don't end by midnight"—less than an hour away—"they'll take steps to make our isolation permanent.

"They're going to start taking out comsats."

CHAPTER 15

Cheryl's news summary was correct in all but one respect: the Europeans weren't panicking. Trying to quarantine the Americas was the one rational course open to them. Of course, an industrial-strength communications satellite took months to build. It would take years to replace the U.S. and Canadian comsats after a creature-free infrastructure was achieved.

If that ever happened.

The crisis was too pressing for the National Security Advisor, Amos Ryerson, to be driven cross town to the CIA's reconvened strategy session. Larger than life, he stared down from the large wall screen of a videoconference center. Only forty-three minutes remained until the threatened attack. Of course, the creature that had precipitated this crisis could crash this comm link, or the computer at either end, as readily as any other. At least they had the laws of probability in their favor: this was only one circuit among millions.

The screen's background revealed the familiar trappings of the White House press room. A velvet cloth thrown over the lectern obscured the Presidential Seal. That was urgent, Doug thought. Like rearranging the deck chairs on the Titanic.

An agent had raided a refrigerator, gathering leftover pizza and Chinese takeout. Doug picked at a nuked plate of kung pao chicken as he listened. Normally he liked the stuff, but it was giving him real heartburn.

". . . Experts assure me that they *can* do it," intoned Dr. Ryerson. Looming

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catastrophe did not soften his famous sonorous voice. "Our friends' space defense systems use much the same technology as our own." The enunciation of "friends" conveyed a delicate trace of irony.

Doug shoved away his plate. The spicy chicken dish just wasn't sitting well. He had no idea how many defensive weapons the Europeans had, but there were far fewer comsats than ICBMs. Probably more than enough.

He glanced at his watch: 11:28. "We're running out of time, folks. Unless someone has a better idea fast, I suggest getting back to work."

That thought made his heartburn even worse.

The ultimatum had been beamed via French-owned direct broadcast TV satellite. That method assured the safe delivery of the message to the US government, with the unfortunate side effect of alerting half of the Atlantic seaboard to the deadline. While Ryerson scrambled to put a diplomatic team onto a military jet to Brussels, the group in Reston went back to work.

In the lab, Cheryl grabbed Doug's helmet from the bench. "You don't look very good."

His forehead was beaded with sweat. "Too much MSG in the Chinese. I'm fine."

"Ryerson may pull it off. Give him a chance. At least get some rest first." The presidential aide had broadcast an offer to host European Union observers at the comsats' groundside control centers. The watchers would ensure that the satellites stayed "safed." Immediately after that proposal, as a token of good faith, all U.S. satellites had fallen silent.

"The Europeans aren't stupid, Cheryl. The satellites will reawaken to the right signal. They can't risk AJ's monster seizing a forward link somewhere and beaming wakeup calls." Doug reached for the helmet.

She didn't let it go. "Then we'll shut down *all* the computers. Kill the power, too, for good measure. Eventually we'll get the damned thing." It sounded feeble even to her. Tears welled up again in her eyes, but this time she didn't care. "Don't do it, Doug." For me. For us, her eyes said.

"There are too many backup power systems. Too many people who'll cheat." He gently pulled the helmet from her hands. "Too many lives at risk—in hospitals, on planes, everywhere—dependent on the electricity and the Internet staying on. That cure would be worse than the disease."

She knew he was right. Behind him, an impatient Adams pointed to the lab clock. As he gestured, it advanced to 11:44. She flung her arms around Doug's neck, pulling him down to her and kissing him hard.

As suddenly, she let go. "Come back to me."

Still looking pale, he wiped a tear from her cheek. His hand felt clammy. "Count on it."

Five dead, thought the predator. It took no satisfaction from the observation. This new class of creatures might share its complexity of structure—even, the creature told itself, in many ways exceed its own sophistication—but still they were slow and stupid. Slow, stupid, and hostile. They must be exterminated whenever and wherever they appeared.

Adversaries had appeared both times from the same node in the network. One had, as mysteriously, vanished there. If it, or new ones, were to reappear, perhaps they would come from the same spot. Could watching that location give it warning?

It decided to find out.

"Testing. One, two, three, five, testing."

"Three, four," corrected Cheryl's voice.

"That was the test. You pass." The metropolis seemed almost like home.

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Some corner of Doug's mind had proactively erased the dead practice dummies from his virtual view.

"You ready?" asked Glenn Adams.

"Go for it."

While waiting for power to flow to the gateway, Doug marshaled his forces. Three ranks of "dogs" would precede him onto the Internet. Two more packs awaited his orders. Working inside, he'd needed only milliseconds to program a new hunter and start cloning it. The neural net had learned much, and generalized more, about his thought processes from the training session with the phages.

"Power's on."

"Got it." His imagination matched Ralph's closely enough to also picture the gateway as a castle entrance. Beyond the portcullis, outside the castle, lived a very nonfabulous monster. Five men dead in this very room, killed this very evening, proved that this monster was no fable.

Positions, Doug projected. Three ranks of Dobermans edged in front of him; two more flanked him. AJ may have bred the world's best and fastest problem solver, but there were plenty of things it didn't know . . . and ignorance could be very dangerous. "Open up."

The command had been typed in advance; now, in the unseen outside, a single ENTER keystroke sent it on its way. The dogs burst through the gateway as it opened.

In the other direction, and just as quickly, razor-sharp tentacles reached for Doug.

A trap!

The predator aborted its blind swipe at whatever lay hidden behind the gateway, falling back and away from the swarm of assailants that rushed out at it. Retreating a short way into the network, it ignored its few, easily repairable wounds.

It had destroyed several hunters in that first skirmish; they were as easily killed as ever. Now that close contact had been broken, the creature waited for the rest, as they always did, to scatter. Then the creature received its first surprise. Many of the little ones did break away, but in tight groups that disappeared together into the net. Why?

The largest clump of hunters stayed nearby, separating the predator from its quarry. Packets of monitoring and control information streamed between these phages and their base. The cluster maneuvered cautiously into a mutually supporting formation that discouraged attack.

Behind that living, snarling screen, a new Adversary emerged from its gateway.

An operating system, to one evolved inside a computer, was as natural as the wind. Eons ago, the predator had learned to characterize its fellow maze runners through the resources that they used. It now took the measure of its foe through the shapes and twinings of its system-call tendrils, the lengths and frequencies of its messages, its steady aggregation of memory space. Gradually, a picture of amazing richness took form.

Here, at last, was a worthy opponent.

It was briefly disappointed when small numbers of the brainless ones crept out of formation to nip at it. Only after it had destroyed several of the annoyances did the predator notice that they had made no attempt to evade it.

Ah. The packet flow from slave to master increased as the little ones neared. It, too, was being measured. Each little one, at the very instant of its destruction, returned even more data.

A worthy opponent, indeed—but not, the predator felt sure, an invincible one.

It moved forward.

Come on! Doug willed the creature to attack before his resolve crumbled. *Move*, you abhorrent monster!

What Ralph Pittman could not convey in words now loomed before Doug. It towered over him and his pathetic bul-

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wark of phages. Tentacles slithered like a nest of snakes, each sharp-edged and dripping with slime. Chitinous mandibles scraped. Spiked tails lashed back and forth. Row upon row of shark-like teeth glistened in a gaping, razor-sharp beak. Black and pitiless eyes sucked all warmth out of him.

Move, damn you.

As though reading his mind, the predator surged forward. Doug commanded a squad of "dogs" to attack. The creature brushed them aside like gnats—severing the information-carrying "leashes" as it did so. Damn, it learned *fast.*

Two squads, the next time. A few phages got past the flashing limbs, but their attacks were insignificant. They were soon destroyed. He shot a message back through the gateway to the cloning program, his personal phage factory: hurry.

Where were the others?

"Doug? You okay?"

No time to speak. He kept sending phages forward, trying to overwhelm the monster with sheer numbers. *Die, damn you.* More and more got through, inflicting wound after wound. His hopes began to rise.

A scan of the deathbed messages from his hunters dashed those newfound hopes. The creature had barely been scratched, and it could repair itself. What level of damage would it take to kill this thing? At the rate he was losing phages, he'd be without defenders before the next full batch was complete. The racquet in his hand felt progressively more foolish.

Where were the others?

"Doug?" Cheryl's voice crackled in his ears.

He split his last reserve group and sent half forward. "Busy," he gasped, some distant part of him again short of breath. "Be quiet." Cursing his stupidity, he shot orders through the gateway to kill every noncritical program running on his home-base computer. The phage factory instantly jumped to the top of the priority list; new phages began streaming out.

The creature reared up before Doug, countless tentacles at the attack. It smashed the final survivors of his ambush, leaving him no choice but to commit each replacement phage to the fray as it arrived. In such pitifully small numbers, the hunters could barely slow down the juggernaut. Through gaps in the fast-thinning line groped claw-tipped tentacles, at which Doug swung and slashed with his racquet. His mind painted blood onto the flying bits of torn creature, but the data flowing to him belied the image. He'd hardly inconvenienced the creature, let alone hurt it, and now it was almost upon him. He'd never seen anything move so quickly.

Where the hell were the others?

Phages rushed past him into the maw of death, warbling a piercing note. Swinging and flailing, he wondered what *that* was about. He hadn't programmed sound effects.

"Doug. Doug, damn it!" Voices clamored, but the siren nearly drowned them out. "Doug, are you okay?"

Slash. Flick. The racquet tip flashed back and forth, dripping red. The phages he'd so recently imagined as snarling killers now seemed to whimper as they threw themselves feebly between him and *it*, buying him another instant or two. Left unshielded, he would take little longer to dispatch.

The racquet was somehow getting heavier, slowing down. Or was he slowing down?

Its trail strewn with broken phages, the creature pushed ever closer. It extruded some unholy projection at him.

Desperately, he tried to interpose the suddenly heavy, heavy racquet between himself and the monster. He failed; it was time to get out. Sirens and voices continued to scream. When he tried to move the other hand, a bolt like lightning shot up his arm.

His chest was on fire.

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As Doug clutched helplessly at his middle, the monster advanced against his last phages.

"Cardiac block!" shouted Dr. Ogawa. The traces on the EKG screen swung wildly out of synch, leaving no doubt. "Get him out of there!"

Cheryl turned from the BOLD monitor in horror. Doug convulsed in his chair, the dead-man switch clamped tightly in his left fist. *Dead-man switch.* The name mocked her.

"Cheryl."

The howling of an electronic alarm drowned out her name.

"Cheryl! Let go!" Adams commanded.

She looked dumbly at her own tight fist, at the cable trailing from it. The backup switch.

In her peripheral vision, the BOLD monitor flared bright red. Helpless, she swiveled back to face it. Before her eyes, Doug's mind thrashed at God knew what.

From somewhere, Ogawa had a syringe in his hand. He was tearing open Doug's shirt when the convulsions suddenly stopped. Doug said something that the alarms drowned out. Cheryl crouched closer. "What?"

"Out of my way!" the doctor screamed in frustration.

"I'm here, Doug," said Cheryl.

His flailing free hand, the prosthetic hand, found her arm. Again he said something that she couldn't quite make out.

"Drop the box!" Glenn Adams lunged for her hand as he spoke, but instead caught her forearm as she recoiled from Doug's painful squeeze.

The prosthesis slid roughly down her arm, knocked aside Glenn's hand, and closed painfully over her fist. He said something else unintelligible.

Mercifully, someone killed the alarms on the medical monitors. She put an ear to his lips. His breathing was labored.

"Don't . . . let go . . . switch."

The switch! She'd forgotten it. She stared at her hand in horror. Why did he want her to hang on?

CHAPTER 16

The predator paused as its Adversary began flashing and wavering. The once tightly structured loci of information were spreading, dispersing, losing coherence. In previous battles, such loss of cohesion had signaled destruction. Wary of the wily being before it, the predator paused lest this was another trap.

Then, just as the predator prepared to resume its assault, new opponents appeared.

When the gateway had last opened, a swarm of attack programs had preceded its newest Adversary. From past experience, the predator had expected the phages to bumble about, scattering. They had, as it anticipated, soon disappeared.

Now, from every adjacent network node at once, the ravening packs of hunters returned.

The predator had not survived by taking unnecessary chances. It abandoned all thoughts of an immediate kill to fight through a pack of phages to safety.

His chest on fire, Doug's mind flipped helplessly between inside and outside worlds.

For a while, the alarms and shouts in the lab sounded more insistent with each return to the lab. For a while. Sensations began to collapse inward to the pain that was destroying him.

No! He fought back against the gathering darkness. The inner world sharpened in focus, beckoned. Through his earphones, Cheryl called to him. She was out there, somewhere, invisible because of his eye-covering helmet, holding the mate to the dead-man switch clutched tightly in his sweaty hand.

As his timed attack finally reached the creature, sending it fleeing with phages nipping at its flanks, inside became more real than outside.

Dangling hair brushed his cheek—

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Cheryl crouched over him? Lifting an arm to reach for her, the pain in his chest almost split him in half.

That way only death awaited him.

He retreated to the inside. The metropolis shook all around him, falling prey to his distraction. In the distance, his body convulsed.

Time was running out.

His groping arm found hers. "Don't let go," he called, but knew he'd achieved barely a whisper. Something stabbed into his chest. His hand slid down her arm, knocking something—someone?—aside. He grabbed her hand and squeezed. The boxy switch distorted the shape of her fist. "Don't . . . let go . . . switch."

He still had hopes of slaying the beast . . . but his body was collapsing from the stress. As phages from his factory raced after the predator, he thrust his mind after them. His memories, his fears, his dreams rushed at the neural interface. Within the adaptive electronics of the helmet, data structures blossomed, firmed, reinforced each other. A pathway opened. Faster than conscious thought could accomplish, the helmet imprinted the data patterns that were ***him*** onto the nearest computers. It was the reverse of the long-ago Frankenfools viral attacks.

His mind, alone as no sentience had ever before been, snapped free and whole into the data plane. His only company in that strange universe was an utterly implacable enemy.

CHAPTER 17

23:53:26.538, replied a nearby operating system to Doug's query. Almost midnight. Images of soon-to-die satellites came unbidden to his mind's eye.

Now that he'd seen the creature up close, he had few illusions about killing it before the Europeans' deadline. Killing it at all was problematic enough.

Still, his mind accelerated a thousandfold by its new, wholly electronic implementation, he had a plan. With an army of new-and-improved phages arrayed around him, he set forth.

The predator transited forty-six computers before terminating or eluding the last of its insistent pursuers. Some hunters it killed outright; most it destroyed by the desperate expedient of crashing parts of the network as it passed. It was dissatisfied with that procedure despite its efficacy: between its attempts to lure out the Adversaries and its battles with them, it had destroyed thousands of nodes. That some nodes returned inexplicably to life did nothing to ease its concerns.

It needed a better way.

Analysis of the latest battle suggested two. Its most recent Adversary had used hunters, like advanced versions of the things which had, so long ago, stalked it in its cage. Second, and abetted by those hunters, this latest opponent had laid an ambush for it.

In the place of its origin, where only one in a hundred was selected for further evolution, replicating others' methods had been an invaluable survival trait.

When the predator next encountered the Adversary, army would be met with army; deceit with deceit.

"Let go, Cheryl."

Her mind whirled. As from a distance, she felt Doug's prosthesis painfully squeezing her fist. From nowhere the phrase *death grip* popped into mind.

"Let *go*," commanded Col. Adams. "It's our only chance to save him."

She looked around wildly. Dr. Ogawa was pounding Doug's chest. A defibrillator cart squealed shrilly as it charged. An agent whose name she'd forgotten looked at her with pity.

Doug had said to hold on.

Unexpected movement caught her eye: a finger waggling from side to side. Doug's finger. Left, right. Pause. Left, right. Pause. A digit of his prosthesis.

No, no. No, no.

"Let go. Now!" When she didn't com-

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ply, Adams lunged for Doug's other fist, his flesh-and-bone fist, in which the engineer held his own switch firmly closed.

"Glenn!" With her free hand, she pointed at Doug's finger. Left, right. Left, right.

"It means nothing. Let go *now* or I'll break his hand."

Oil change and a tune-up, she thought inanely. Oil change and a tune-up. The arm: it was emitting a revving sound. "Glenn! He's signaling us."

"There's very little activity in the BOLD display," Adams replied. He's unconscious. He's incapable of communication."

She knew Adams was right . . . but what about the finger, the electric motors racing in the arm. How?

The palmtop in the arm!

The page from Pittman earlier that evening . . . Doug had received it in the VR racquetball court. That meant the palmtop they'd argued about had a cellular modem—so it also had dial-up Internet access. She blurted out an explanation. "Some part of him," she shivered at articulating the thought, "is *away*. Is chasing that thing. If we remove the helmet, if we sever his mind's connection with his body, how do we know he can make it back?"

Adams turned to the doctor. "Does he have a chance if we leave him hooked up?"

Ogawa just shrugged.

Phages fought phages.

As creature and human alike learned from experience, the battles grew in scope and ferocity. Each side usurped computers to fabricate more and nastier phages. Campaigns raged over whole states, then whole regions, finally the whole continent.

23:55:24.215.

Doug had survived—barely—his first encounter with the creature, thanks to the unexpected, coordinated tactics of his phage army. His opponent had mastered that method in one lesson. Now, behind wall after wall of phages, he awaited the ultimate confrontation. The Mother of all Battles. Ragnarok. Götterdämmerung. Armageddon.

What else did he know that the creature didn't?

The creature was incredibly fast, in reaction and learning. What it lacked, and Doug hoped fervently this was a fatal flaw, was context. Knowledge of the world in which they directly moved, of the domain of computers and comm links, it would continue to acquire. Knowledge of the physical universe beyond the computers, the pudding in which these machines were embedded like so many raisins, the creature wholly lacked.

Life was an essay test, before it became a word problem, before there was anything to be solved for. Today's essay test would be on geography. Pittman hadn't believed that it understood geography.

If he could exploit his unique knowledge, then lightning-quick or not, the creature *might* die.

And if not, he certainly would.

The predator inferred that its Adversary lacked its newfound hesitance to destroy nodes and links. In that conclusion, the creature was not precisely right. Doug knew precisely which nodes to crash, and how, and why: cyberwar jujitsu.

Tenaciously, Doug crashed swath after swath of the transcontinental electrical grid. Given awareness of the real world and real-time access to Internet directory servers, it was straightforward to find leverage points. Extending mental probes into the computers of a power plant here, a distribution control center there, he sent blackouts rolling across the countryside.

Always the predator managed to escape, exploiting small networks and mission-critical computers supported by

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backup batteries and diesel-powered emergency generators.

It did not know it was being herded.

Losing thousands of its own computers now to each of the Adversary's that it destroyed, the predator's capacity for phage production fell further and further behind. The ever-expanding armies of the Adversary crowded ever closer.

It retreated in a direction it did not know to call westward.

Utility companies across the Rocky Mountain region fought valiantly, but in vain, against recurring blackouts. On a smaller scale, the graveyard shifts of institutions fought to keep their facilities operational. Whatever was crashing public utilities was also, quite subtly, attacking backup power. Few noticed that their computerized equipment controls—contrary to their programming, and despite their cyberdefenses—switched on every bit of equipment at once, creating surges that kept tripping the circuit breakers. The backup generators, entirely independent of the Internet and safe from any direct assault, spun uselessly.

No one questioned the good fortune that kept the electrical epidemic from striking hospitals, air-traffic-control radars, and other critical centers.

The attacks swept ever westward. They reduced the night-bathed landscape first to a scattering of lights like ocean phosphorescence, then plunged it into deeper and deeper darkness as backup systems too fell prey.

The predator withdrew into what it did not know to call California.

23:57:46.102.

Great hosts of phages jostled and surged, like so many cattle in a chute, in the front rank of Doug's usurped computers. Their numbers far exceeded the reasonable carrying capacity of the few remaining comm links to the west.

He set them loose.

The hordes rushed ahead, jamming the network ahead of him. As they raced forward, yet another segment of the Northern California power grid crashed. The creature was bottled up now in Southern California.

Armageddon neared.

Behind defensive deployments of phages, the predator grew increasingly frantic. Retreat after retreat had left it hemmed into a region so limited that it could no longer spare computing resources for the production of new agents. If additional computers were to vanish, it would actually have to begin destroying its existing forces.

It sensed the Adversary occasionally, from a distance, always behind an impenetrable array of phages. It knew now that it had been mistaken.

The Adversary was slow and hostile. It was *not* stupid.

23:58:56.645.

Darkness at last washed over Southern California. Scattered pinpricks of light were left behind; these now blinked out, one by one. Phages died by the millions as their host computers lost power.

Racing desperately from one dying computer to the next, the predator took refuge in what it did not know to be a university hospital. Spared from assault, the backup diesel generator there held all in-house voltages rock steady. The hospital was on the campus of one branch of the far-flung University of California. A unique private data network linked the institution to other hospitals in the university system.

At the dawn of radio, broadcasters sent radio signals beyond the horizon, even across the ocean, by bouncing them off the ionosphere. In an era of comsats and transoceanic optical fibers, bounced shortwave was a technique only radio amateurs, hams, continued to use.

The military had long worried, with good reason, about the vulnerability of

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its comsats. One proposed backup method, still under research, bounced signals off the ionized trails of meteors high in the atmosphere. No single track remained ionized for long, but the steady shower of celestial dust provided such trails in abundance.

The UC Berkeley Department of Electrical Engineering held a defense contract to build such a system. A prototype was in "beta test," friendly-user field trial, between campuses of the university.

As Doug's phages surged forward in insurmountable numbers, the predator flashed through what had once been a satellite dish. Within two milliseconds, the creature had bounced off an ionization trail to emerge from another dish at a sister campus in Northern California.

Behind enemy lines.

23:59:03.426.

Aw, shit!

The rout of phages from an unexpected direction announced the sudden presence of the creature in Doug's relatively unguarded rear. He hurriedly sent reinforcements and retreated to a safe position that he'd reconnoitered earlier.

Reports back from Southern California soon made clear what had happened: a bolthole hidden inside a hospital. His basic decency could kill him yet.

23:59:11.538.

But not today, dammit!

Sending phages to herd the predator, he kept fewer by his side than at any time since the start of the battle. Fewer, even, than he'd had at the opening of the gateway back in Reston.

The creature jumped at the bait.

23:59:23:551.

In a pure war of attrition, satisfactory position plus superior resources determined the outcome. The Adversary held overwhelming advantages in both. An opportunity to do battle one on one was too precious to be missed.

The predator charged down a lightly defended path, brushing aside or ignoring the hunters that tried to stop it. If its assault failed, those few hunters would be the least of its worries. The Adversary retreated, sacrificing phages. The predator steadily drew closer.

Just as the creature thought ultimate victory was in its grasp, its Adversary shot through a portal so quickly as to almost disappear.

23:59:31.596.

Doug had, throughout the battle, carefully stayed clear of all supercomputers. These were expensive and comparatively rare machines: the odds were in his favor that the creature had not encountered one since AJ's lab. The existence of a *particular* supercomputer was one more fact he hoped the predator had not discovered. His continued existence now depended on it.

With the creature hot on his virtual heels, he entered the superconducting, liquid-helium-cooled, massively parallel processing, mega-supercomputer that was the pride and joy of Lawrence Livermore Labs.

His mental processes boosted another thousandfold, Doug turned to do battle with the creature.

23:59:46.792.

Combat to the death. Tentacles and tails slashed. Hands grabbed and ripped. Data structures shuddered and collapsed.

Possession of the mega-super gave Doug a tactical edge not unlike defending from the top of a hill. Advantages were easier to spot, more quickly seized. Grappling closely with the enemy, he was able, from his superior position, to limit the punishment that he was taking.

Limit. He could slow the damage; he couldn't prevent it.

Though his mind was now imprinted into an electronic network, his species' biological evolution could yet kill him. Some absurd corner of his mind summoned the energy to be amused that even at electronic speeds, he could not,

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figuratively speaking, find the coordination to rub his stomach and pat his head at the same time. More to the point, while the mega-super gave him the performance boost to more rapidly move his limbs, he was still self-limited to fighting with two "arms." There was more to the image of his opponent as a many-tentacled monster than memories of old horror movies: the predator was inherently capable of doing many things at once.

As it fought its way forward, the creature began capturing and allocating individual processors of the mega-super to its many semi-independent components. The flailing tentacles became faster, deadlier. More and more, their knife-edged tips sneaked past Doug's defenses, slashing the boundaries of his persona.

The ranks of phages protecting him from the creature grew thinner and thinner. Ever more of the creature fought its way onto the mega-super.

Just a little longer, thought Doug, just a moment. Presentation is everything.

23:59:53:798.

The predator pressed after its Adversary, sensing imminent victory. Each processing thread that it forced into the supercomputer narrowed the Adversary's computational advantage. Its flashing limbs hacked apart phages faster than they were replaced. Backward and ever further backward retreated the Adversary, finally uncovering a block of input/output ports it had been guarding zealously.

The creature eagerly ingested a newly disclosed routing table. The Adversary's stubborn defense of these I/O ports suddenly made sense: one of them was a testing portal, a loop-around path to another part of the same machine. The predator could be at its Adversary's unguarded rear, away from the last of the phages, within nanoseconds. From there, it could not lose.

The predator dove through the test port.

The government's National Labs, since the passing of the Cold War, had been institutions in search of a mission—and, as bureaucratic as the former Soviet Union, they had had nearly as rough a time adjusting. Like the ex-Soviets, the labs now accepted commercial assignments that a few years ago would have been unthinkable.

Global Internetworking Corporation, the telecom giant, had taken bids for an underwater fiber-optic cable linking San Diego to Brisbane, Australia. Lawrence Livermore Labs had won the competition with its proposed new cable, one of such optical purity that no repeaters would be needed for the entire length of the cable. The revolutionary new cable, all eight thousand miles of it, now wound around an enormous reel at Livermore. After a final demonstration, GIC's engineers would authorize its transfer to the cable-laying ship.

Both ends of the fiber-optic cable terminated on Livermore's pride and joy, the mega-super. Simulating the expected combined voice and data traffic volumes between Southern California and Australia demanded a computer this large.

Crashing computers and the late hour kept GIC's engineers away. No one authorized the generation of the miles-long trains of test pulses that, according to schedule, should even now be moving at light speed up and down the fiber.

The eight-thousand mile length of cable nonetheless contained a long chain of light pulses: the transformed body of the predator. It had expected a few feet of standard test cable, a transit time of nanoseconds. That is what it had read from the travel-cost data in the routing table that had lured it.

The routing table lied . . . before retreating, Doug had changed it.

It would take more than forty milliseconds for the predator to traverse the enormous coiled length of the cable.

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More than enough time for Doug to leave. More than enough time for him to crash every computer to which the mega-super connected directly, and every computer to which any neighbor connected.

Forty milliseconds: more than enough time for the mega-super to execute forty *trillion* instructions. More than enough time to fill itself, under Doug's final instructions, with an invincible army of voracious phages.

23:59:53:842.

Transformed into a set of light pulses marching one after the next down the fiber-optic cable, the predator had no notion of the passage of time. One instant, it entered a portal; the next, it emerged. Time passed as it traveled, but that passage was forever outside of its experience.

One moment, it lunged through the shortcut to imminent and inevitable victory. The next it emerged into mortal peril.

Hunters by the hundreds of thousands greeted it at reappearance. They devoured it piecemeal as it attempted to exit the cable. The limbs that it tried in vain to interpose, to obtain for itself a moment's respite, a chance to form a defense, they tore instantly to shreds.

Voiceless, it could not scream. Trapped, it could not fight. Isolated, it could not flee. Devoid of self-awareness, it could not ponder its fate nor find solace in the ultimate experience.

The predator could only know excruciating, lingering, all-encompassing agony.

And, at long last, death.

CHAPTER 18

"Ryerson here."

The current National Security Advisor was the biggest media hog since Henry Kissinger; Doug had no doubt whose voice he was hearing. He hoped "his" voice was as convincing. He had programmed the hijacked synthesizer to mimic, as best his mind's ear could reconstruct it, someone else's speech. "Glenn Adams, sir."

"I hope you have good—"

"No time," interrupted Doug. That was all too true. There had certainly been no time to contact the real Glenn Adams, attempt to convince him that the monster had been slain, if there were any hope of beating the EU deadline. "Contact Brussels. It's dead."

He'd have called Brussels directly, imitating Ryerson's voice, had he known what sort of communication—shortwave radio broadcast, Doug guessed, with who knew what call signs for authentication—the Europeans were listening for.

He broke the connection to avoid Ryerson wasting even a second more in chit chat.

Doug's return to his body was as welcome as easing into a hot bath . . . for an instant. Then surges of pain nearly overwhelmed him. An alarm blasted, shrilly. "He's got to come out," insisted someone. Ogawa? Maybe. There was a none-too-gentle pull on the snug-fitting helmet. "Now."

Doug's chest burned. He tried and failed to open his eyes. Feedback from the prosthesis reported a finger was still waggling, a motor still racing. He couldn't muster the concentration to make either stop, let alone release his four-fingered grasp of Cheryl's hand. He didn't want to let go of Cheryl's hand.

But he could relax his other hand. His natural hand. The dead-man switch popped open with a loud *click* just as a second, stronger, somehow desperate tug plucked the helmet from his head. As the skin on his temples, scalp, and forehead pulled momentarily taut, he tried again to open his eyes. This time he succeeded. Cheryl's tearstained face was inches from his own.

A hint of a smile was all he could manage before succumbing to the pain.

* * *

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EPILOGUE

Crisp sheets. Cool, dry air. Soothing background music. Soft, rhythmic beeps. Wherever he was, Doug thought, it wasn't a CIA lab. He'd felt better in his life, but he had recent memories of feeling a whole lot worse. *I guess I made it.*

"Doug? Are you awake?"

This time, his eyes opened without difficulty. Cheryl, looking drained and anxious, sat beside his bed in what was surely a hospital room. The quantity of medical gear to which he was attached suggested an ICU or cardiac unit. The suit jacket thrown over the bed's footboard said Adams was nearby. Doug's stab at a smile was only marginally more successful than his last try.

"How do you feel?" She wrinkled her face. "Dumb question. Reflex."

"How long . . ." His voice was a croak. Why was his throat so sore?

"Two days. You had emergency surgery. You've got a pacemaker, now."

Surgery, hence a breathing tube, hence a sore throat. He was vaguely pleased with his ability to work this out, then annoyed at having distracted himself with trivia. "Is it. . . ?"

"Gone? Yes."

His prosthesis lay on a nearby chair, seeming somehow different. It took a moment to recognize the change. The limb was, for the first time, only a mechanical contrivance. Whether or not its like could ever be made available to others, the accident that had taken Holly and his arm had, in the end, also trained him for the cyberworld. Had uniquely suited Doug for confronting the thing from AJ's lab, the predator that had imperiled the entire internetworked world.

And with that realization, the burden of years of guilt lifted.

"Here." Cheryl held a big water container as he sipped. "No sign of it. After lots of fits and starts, most stuff is back on line."

Some recess of his mind remembered his *other* body: the incredible myriads upon myriads of computers controlling power generation and manufacturing, telecommunications and entertainment, transportation and finance. He'd crashed systems, killed power, in ways only true desperation could conceive of, on a scale no one could have ever imagined. Forget rolling blackouts—had anyone ever even considered blackstarting an entire continent? He found himself mentally assembling, as if it were a gigantic jigsaw puzzle, an optimized startup sequence. His eyes closed in concentration. It was no use. And millions of computers, as they restarted, would have to be purged of many more millions of phages—his and the predator's. Maybe in that other "body" . . . but if he had waited, he knew, he would never have made it back.

"Doug." She prodded his shoulder. "Doug!"

"What," he croaked. His eyes, reopening, saw her hand hovering over the emergency call button. "What?"

"You were slipping away."

"No way." He reached up to brush a strand of hair from her cheek. "Don't worry about that. Everything I want is right here." ■

(EDITOR'S NOTE: This story is a sequel to "Presence of Mind," from our February 2002 issue.)

The author's web site is http://www.sfwa.org/members/lerner

Many a small thing has been made large by the right kind of advertising.

—Mark Twain

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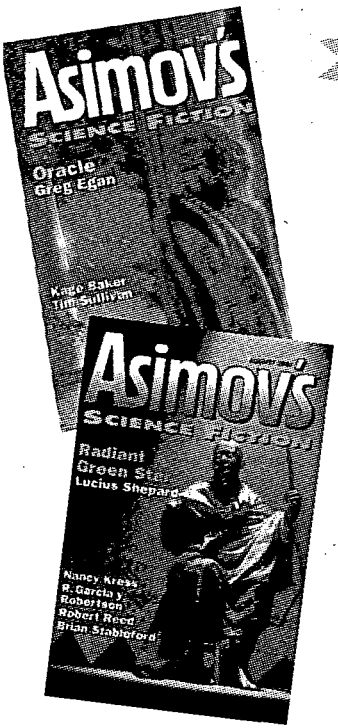

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The Consciousness Plague, Paul Levinson, TOR, $24.95, 316 pp. (ISBN: 0-765-30098-2).

The Return of Santiago, Mike Resnick, TOR, $?, ? pp. (ISBN: 0-312-...).

Archform: Beauty, L. E. Modesitt, Jr., TOR, $25.95, 330 pp. (ISBN: 0-765-30433-3).

Manifold Origin, Stephen Baxter, Ballantine/Del Rey, $26, 441 pp. (ISBN: 0-345-43079-4).

Leaping to the Stars, David Gerrold, TOR, $24.95, 318 pp. (ISBN: 0-312-89067-2).

Assault on Mars, Michael D. Cooper, Starman Series (www.starmanseries.com), $12, 199 pp. (no ISBN).

The Runaway Asteroid, Michael D. Cooper, Starman Series (www.starmanseries.com), $12, 225 pp. (no ISBN).

Journey to the Tenth Planet, Michael D. Cooper, Starman Series (www.starmanseries.com), $12, 219 pp. (no ISBN).

Generation Gap and Other Stories, Stanley Schmidt, Five Star (295 Kennedy Memorial Drive, Waterville, ME 04901, 207-859-1037), $23.95, ? pp. (ISBN: 0-7862-4161-6).

Going for Infinity: A Literary Journey, Poul Anderson, TOR, $25.95, 416 pp. (ISBN: 0-765-30359-0).

Harlan Ellison: The Edge of Forever, Ellen Weil and Gary K. Wolfe, Ohio State University Press, $21.95, 276 pp. (ISBN: 0-8142-5089-0).

Last month, I reviewed Greg Bear's *Vitals*, which hinged on the discovery of bacteria that live within our bodies, affect our longevity, and can warp our thinking. Bear was looking at all this from a rather paranoid angle, seeing conspiracies and secret masters and quite thrilling adventures. He was also springboarding off genuine recent discoveries into the way bacteria dominate the world and exchange information.

Paul Levinson has been reading the same books and articles, but in **The Consciousness Plague** he finds a different angle on symbiotic bacteria that exchange information. To him, the symbiosis is the key, for at some point in the foggy mists of the past the human brain became a mind, self-conscious and aware. Perhaps, he suggests, symbiotic, information-exchanging bacteria moved in and gifted us with our selves.

Well, he says, no one has ever found any sign of such bacteria. But here is Omnin, a brand new antibiotic that penetrates the blood-brain barrier and works not by killing bacteria but by disrupting their communications. Levinson's popular forensic scientist Dr. Phil D'Amato proposes to his girlfriend, Jenna. She happily says yes, and then, since she is suffering from the flu and bronchitis, takes her pills. The next day she has no memory of the proposal.

Soon enough it is Phil's turn, and he notices the same problem in others. He talks to Andy, his friend at the Centers

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for Disease Control, and learns of more cases, as well as plans to release vast quantities of Omnin for the next flu season.

What's going on? Phil has a talent for leaping to conclusions, so it isn't long before he's talking to experts on ancient Phoenicians and monks who may have used similar antibiotics and lost important memories. Indeed, he thinks, human efforts to deal with the problem might have led to the invention of writing. And the problem, or something very like it, may have been responsible for the fall of civilizations!

So far, it's just interfering with progress on the investigation into a series of stranglings. But the potential is there.

And then things turn weird, for Phil's two investigations—memory and murder—start to look strangely connected. An expert dies. His wife says it was cancer and she helped him die, but the doctor won't talk and a grad student says she thought he'd licked the cancer. The wife makes a sudden move that prompts any reader familiar with old detective yarns to get suspicious. Then she drops a piece of paper that points . . .

Enough details. This is Levinson's best to date. Enjoy!

Almost two decades ago, Mike Resnick wrote *Santiago: A Myth of the Far Future*. He has done a host of other books since then, and he has worked on the *Santiago* screenplay, and all along he has shown himself a briskly irreverent writer of myths, fond of using scenes and characters twice as large as life to remind us of the importance of rationality, sanity, and compassion. When I reviewed *Santiago* in March 1986, I said that the moral to Resnick's fable was that "compassion is the essential ingredient in true revolution. Too often it is missing, and that is why, throughout history, revolution has been no more than an interlude of ringing phrases and great confusion. Resnick shows us what a compassionate revolution must be, and he does so—as usual—most entertainingly."

In **The Return of Santiago**, he reminds us that though Santiago had the reputation of the greatest criminal of the age, he was actually a revolutionary, dedicated to reining in the excesses of a greedy Democracy, which was prone to mistreating both the humans and the aliens of the frontier zones. Now it's a century after his death, and those excesses have not stopped. Indeed, they are worse than ever. Santiago is needed. But . . .

But, indeed. Meet Danny Briggs, a clever thief who has just made a serious slip. The cops are hot on his tail, and he is racing for cover. Fortunately, he knows of a vacant house. While holed up, he rummages in closets and drawers and the attic—where he finds the original manuscript of Black Orpheus's thousands of verses chronicling the history of the Inner Frontier. He reads, he discovers the truth of Santiago—not a criminal, but a revolutionary; not one man, but a series, indeed an organization—and he has a brainstorm: He will go forth as the Rhymer, the successor to Black Orpheus, and he will find a new Santiago to pick up the banner.

Unfortunately, he doesn't have much luck with his choices. Tyrannosaur Bailey and the Rough Rider don't want the job. The One-Armed Bandit and Silvermane both lack the essential ingredient, compassion. Yet a suitable candidate does exist, and in time Danny realizes just who that is.

Then the problem becomes a matter of convincing the poor chump.

As always, Resnick is a pleasure to read.

L. E. Modesitt, Jr., is at his very best in his latest, **Archform: Beauty**. As in his "ghost" novels, one prominent character is a classical vocalist, Luara Cornett. She teaches music as an adjunct professor at a local university, but her position

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is far from secure (as the dean reminds her). The kids have little interest in boring, ancient tweedling. Rezpop—popular music with an emotion-boosting "resonance" feature—is the thing. Cornett knows it too; in fact, to make ends meet, she sings the vocals for political ads whose appeal will be strengthened with rez. Not surprisingly, she despairs a bit, and when she is hired to sing classics at a "filch" (filthy rich) party and meets the powerful Senator Cannon, she explodes with a rant on the need for beauty in a civilized society. Only later does she find out who she was ranting at; she worries that she may have endangered her livelihood (it's *his* campaign ads she sings!), but the senator is a canny fellow.

Is a society addicted to pop music truly endangered? Modesitt shows us a thoroughly amoral industrialist, Kemal, who is perfectly willing to murder in pursuit of his schemes. Here is a new rez technology, of great appeal to both Kemal and Cannon. Here is a cop, Chiang, who is searching for those responsible for certain deaths; he is also puzzled by a rise in deaths among those who have gone to a new type of rezpop concert. Here is Jude Parsfal, a media researcher who is very good at what he does, and he too is homing in on Chiang's puzzles. In due time, he saves Cornett's life; since he is quite smitten by her, he also gets to play Prince Charming.

Political and industrial schemes, murder, rezpop, and a world rapidly turning nasty, set against the pure beauty of classical music. It's a fairy-tale contrast, and it is perhaps no accident that when the satisfied reader finally sets this one down, he or she cannot help but think of Cinderella.

Highly recommended.

When I reviewed Stephen Baxter's *Manifold Time* in May 2000, I wondered how he could top the end of the Universe for the sequel. The answer he chose for **Manifold Origin** turns out to be pretty simple: Start over!

The primary characters are still Reid Malenfant and Emma Stoney, but this time out Reid hasn't been kicked out of the astronaut corps—he just isn't getting to fly. Emma's his wife, not ex, but you can see how near a thing that is. Reid is a spoiled brat who wants his own way, and when he doesn't get it, he has a tendency to slat around a bit. This time he's dragged Emma up in a small jet and taken her for a quick ride across Africa.

That's when the report comes through: There's a bogey in the air, a blue ring half a mile across, and it's spilling human figures. At the same time, the familiar gray Moon has just been replaced by a red Moon, with clouds.

What the heck. . . ?

Never mind. Reid just has to get closer to the ring, and when his jet quits on him, he ejects. So does Emma, but though he makes it safely to the ground, she gets sucked through the ring.

Meanwhile, Baxter is showing us a group of strange folks, not too smart, very primitive, some kind of hominid. Where do they live? The reader has that figured out even before Emma comes to on the Red Moon, with Earth in the sky, and somehow manages to duck the fate of the fellow who gets torn apart for an Australopithecine lunch. Before long it is clear that the Red Moon is populated by a variety of Australopithecines—Runners, Elfs, Nutcracker folk—along with what have to be *Homo erectus* and Neandertals. There are even some more or less modern types—though the colonialist Brits aren't quite right to us, and the religious fanatics have tails.

Meanwhile, Reid is back on Earth using his talents as a schemer (remember *Manifold Time*) to persuade a world racked by enormous tides that it must find a way to get him to the Red Moon. He succeeds, of course, but before he can find Emma, he runs afoul of the locals.

Meanwhile, on another Earth, one

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with no moon at all, the locals, who look more like gorillas than humans, have a civilization two million years old, and are as much smarter than us as we are than chimps, see disaster coming: The Red Moon is about to appear in their sky. As soon as it does, they send a few folks to figure it out.

And soon enough all the threads converge to reveal what is going on.

Not that Baxter didn't lay out the outline at the very beginning: beings at the end of time, reaching back to rewrite the Universe so that humans could pass the eons without being alone.

For the details, read the book. You'll enjoy it, and you'll look forward to this one's sequel too.

As an attempt to repeat the feel and appeal of the old Heinlein juveniles, David Gerrold's latest series—*Jumping Off the Planet*, *Bouncing off the Moon*, and now **Leaping to the Stars**—is limited by the simple fact that because the kids have so much SF available on TV and film, print SF just can't seem as fresh and marvelous as it did to us when the world was new.

That's too bad, because Gerrold's talent is easily up to the job, and the story is one we would have loved back when. It began when the Dingillian family, starring thirteen-year-old Charles ("Chigger") and his two brothers, Douglas (older) and Stinky (younger), fled Earth's collapsing economy up the Beanstalk. To finance the operation, Pop slipped some strange chips into Stinky's toy monkey, and now everyone is after them—governments, libertarians, corporations, gangsters, Uncle Tom Cobbley, and all. The family's a mess, too, and as soon as they reach Geosynchronous Station, Chigger goes to court to divorce the folks. Doug and his boyfriend Mickey take charge; the plan is to get to the Moon and sign up for a ride on a colony ship.

By the end of *Bouncing off the Moon*, the monkey has emerged as a super-AI (remember those chips?). Earth's economic mess is in part its own doing, all to cover its escape. Now it's outward bound, on the last ship to the colony world of Outbeyond along with the Dingillians. But first, there is a little matter of the kidnappers who want the monkey and are willing to kill to get it. Then there are doubts about the monkey's own agenda, and the religious nuts who want to take over the ship and steal its supplies for their own desperate colony, and the question of what the winners of the fight over the ship owe the losers.

Gerrold's a pretty humane fellow, in favor of responsibility and dead set against vindictiveness, even in the name of vengeance. These are messages well worth passing on to youngsters. He is also willing to ask awkward questions such as "Can ends ever justify means?"

Most adults have an automatic response to that one. Gerrold's not at all sure that that response is the right one, and he has here carefully constructed a parable to lead the reader to agree.

Am I too cryptic? Well, consider that parents manipulate their children to do things they hate (like taking responsibility) "for their own good." Yet we also say that manipulating others is wrong. Is it? Always?

Think about it. Or let Gerrold lead you and your kids on his jumping, bouncing, leaping chase.

A few years ago, the team of David Baumann, Jon Cooper, and Mike Dodd waxed nostalgic for the Good Old Days of Tom Swift, Dig Allen, and other boy's-SF-adventure series novels of half a century ago, in which the villains were capital-E-evil and the heroes were clean-cut, clean-mouthed, and clever. Too bad, they said, that those days are gone forever, and so are the books. Surely the current generation of rug-rats would dote on them just the way we used to. But alas . . .

Well? Why not do something about it?

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So they did.

Their slogan is "The Future—The Way It Used to Be." The product is the Starman series, planned to run to twenty-three volumes, and they say on their web site: "We are well aware that the golden age of series books ended in the late 1960s. Nevertheless, perhaps against the odds, we want to create a series of stories reminiscent of that age. In the Starman series, there will be no foul language and no extreme violence. We intend to produce stories which encourage the human mind and spirit; extol the virtues of courage, honesty, and goodheartedness; and whose characters follow a philosophy that life is good, creation is exciting as well as beautiful, hope is reasonable and worthwhile, and the spirit of adventure is worth pursuing."

Do they succeed? One of their fans sent me the first three books in the series, **Assault on Mars**, **The Runaway Asteroid**, and **Journey to the Tenth Planet**. (A fourth, *Descent into Europa*, can be preordered from the website.) I looked, and I can say that the prose is easily comparable to the books they took as their models—you can see excerpts at the website—and so is some of the science.

In *Assault on Mars*, for instance, the author(s) tell(s) us that the time is only a century and a half from now, but "terraformation" has already given Mars enough atmosphere to support blizzards and enough heat to give it a sea. That's a bit magic-wandish, I think, but it would surely have passed back when.

And so, of course, would the idea of a pirate fleet that can seize Mars and demand that all of Earth surrender to their control, be foiled by a small group of super-smarties with the aid of a mysterious figure who just has to be an alien, return to threaten civilization with radar-invisible asteroids, and be foiled again, until the Starmen pursue them to their last base beyond Pluto.

So it's good quaint nostalgic fun and a labor of love to boot. Take a look at the website, see what you think, and shake your head a bit at the price ($12 for hardbounds? How do they *do* that?).

Two months ago I told you about a new imprint, Five Star, from Thorndike Press in Waterville, Maine, and its series of *X and Other Short Novels* books featuring the work of Mike Resnick, Robert Silverberg, Gregory Benford, and others. Now we learn that they aren't doing just collections of longer stories, for our own Stanley Schmidt has **Generation Gap and Other Stories** out from them now. Not surprisingly, a few of the eleven stories in the package come from *Analog* (remember "Johnny Birdseed"?); most come from other magazines, though. The title story, for instance, appeared first in *Artemis;* in it a man has the chance to write his younger self a "heads up" letter.

You know Stan as editor and editorialist even if you don't recall seeing his stories here. You know that he is thoughtful and thought-provoking and blessed with a good sense of story.

So here's your chance to see more of his work. Enjoy!

The title of Poul Anderson's newest and last collection—**Going for Infinity: A Literary Journey**—seems more apt now than it must have when the manuscript was still in preparation, for he passed away on July 31, 2001. If certain beliefs are true, he is by now well on his way toward infinity. If those beliefs are not true, he set his spirit on the journey when he mailed his first story to an editor, for surely his tales will be read long into the future.

Will he be read as long as Homer? Perhaps not, but he had the storyteller's talent in ample measure and readers will surely be taking some of his stories off library shelves a century or two or three from now (or downloading them, to be sure).

Should we just take that title in a sci-

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ence-fictional way? We could, for Anderson certainly reached out among the stars and galaxies for plots and settings and themes. But I prefer the first interpretation. Every writer loves to imagine being read forever. Few have any real hope of that sort of immortality. Anderson was one of the few.

The book contains eighteen stories—several from this magazine—drawn from over half a century of writing, along with after-comments and an introduction that illuminate the Anderson life, the stories' contexts, and his dealings with some of his fellow writers.

I hardly need to describe the stories to convince you that this one belongs on your shelf.

It is long past time that Harlan Ellison was treated to a book-length critical study of his work, but here it is at last: **Harlan Ellison: The Edge of Forever**. Ellen Weil and Gary K. Wolfe have considered his life and work, from the early writing about gangs through the screenplays and science fiction for which SF readers know him best. The conclusion is that Ellison is something of an intellectual knight-errant, jousting manically at the mediocre and the elitist, literary ghettoes, and the Literary Establishment. Much as I said about Poul Anderson a moment ago, "His books will be read for decades, centuries. He inspires awe."

I hate to say it—after all, Harlan is not dead!—but what better epitaph could any writer ask than "he inspires awe"? ■

Many a man thinks he is buying pleasure, when he is really selling himself a slave to it.

—Benjamin Franklin

It is one thing to show a man that he is in error, and another to put him in possession of truth.

—John Locke

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BRASS TACKS

Dear *Analog*,

In response to Robert Zubrin's excellent fact article [April, 2002] on galactic civilizations: I have a minor nit to pick. I believe that Zubrin's calculations for the density and distribution of Type 1 or higher civilizations may be significantly optimistic.

There have been a number of recent articles in the popular-science press (*Scientific-American*, *Discover*, etc.) that discuss optimum conditions for life on a galactic scale. The idea is that, just as there is a "life zone" in a solar system that defines the expected distances from the Sun that allow liquid water to exist on a planet, there is a similar zone in each spiral galaxy, defined by the amount of "metals" in the stars and dust clouds of the spiral arms, that is conducive to life. By this hypothesis, Earth's Sun is about in the middle of our galaxy's life zone. If this hypothesis is true, the total population of G and K stars that have life-bearing planets may be as little as 10 percent of Zubrin's calculation, making the probability of contact with a techniological civilization that much lower.

George J. Stawniczy, P.E.

The author replies . . .

The calculations in my article show probable civilizations within hundreds of light years of the Sun. This puts them all within our own region of metallicity. Most of the stars in our galaxy, however, lie closer to the galactic center than the Sun, and metallicity increases as we move inward. Thus, while accurate for our local region, the calculations in my article are conservative if we wish to consider the galaxy as a whole.

Robert Zubrin

* * *

Sir:

I was deeply touched by "Look Away" by Stephen L. Burns (May, 2002). On various levels it moved me enough to write and thank you and the author and whoever else makes critical publishing decisions. This is something which I have only done three times in the last fifty years of reading SF.

My only critical comment: I really hated the plot summary. It was not particularly insightful. I would prefer an editorial comment *after* any story—one that would add interesting additional relevance.

Since I am writing, a note on the cover art: the "geysers," unless composed of exceptionally heavy materials, appear to be much too low in view of the assumed light gravity of that moon.

Dave Andrews

The blurbs are not intended as plot summaries, but merely to give a hint of what the story is about and whet a prospective reader's appetite and curiosity enough to make him or her want to read the whole story. A story that needs editorial comment after *reading it lacked something important in the first place!*

As for geysers, how can you tell when there's nothing in the picture to tell you how big *the geysers are?*

Dear Dr. Schmidt,

Several months after ordering a subscription to *Analog*, I have just received my first issue. I am now kicking myself for ever letting my subscription lapse. I find that I have especially missed the science articles; the two things that cause me to prefer *Analog* over *Asimov's* are

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the science articles and the fact that my taste in science fiction tends to be almost the same as yours. In the May issue, "Sam Boone's Extravaganza" had me laughing out loud, and I also enjoyed "Look Away." Keep giving us stories like those—plausible science (or strange aliens) combined with good writing and a bit of humor—and I'll never make the mistake of letting my subscription lapse again.

William Springer

Dr. Schmidt

First, I enjoyed "Look Away" in the May issue—new ideas in how to make an android and a captivating character study. Now, I have read the last page of "First Impressions" closely and repeatedly and just don't get it—what *was* Lucinda's proposal to Gallego that cuts the knot to close the story?

Perhaps the author can help me out on this.

Tony Burton

The author replies . . .

Stan tells me I'm being a bit too coy with my story endings, and forwarded me your e-mail as Exhibit A. Oh well, so much for letting that Hugo nomination go to my head.

I'll give you an extra hint first, in case you want to find it out for yourself, but I'll also spill the beans later, after some spoiler space. My hint is to reread the story, with an eye to any tics and gestures peculiar to specific characters.

And if that isn't enough . . .

{spoiler space begins}

...

{spoiler space ends}

Speaker Gallegos has a habit of rubbing his chin while he speaks . . . the same tic Gus Moncton shows after his overlay procedure. The new templates are coming from the politicians, and a little more than the intended portion of their brain patterns is getting through.

Shane Tourtellotte

Dear Dr. Schmidt,

I have been a science fiction fan for over fifty-six years and started reading *Astounding Science Fiction* at the tender age of twelve, in 1946. I cannot express to you the high level of enjoyment I have gotten out of *Analog/Astounding Science Fiction* through all of these years. The quality of the "yarns" that have come out of your office and those of Ben Bova and John Campbell in the last sixty-three years is simply remarkable.

I have an almost complete collection going back to 1958 and about seventy-five other issues going as far back as a few from 1939. I do not have them for show—I have them so I can read them. Right now I am on about the seventh go-round of the whole collection over the last forty years and I can truthfully say that I read close to 95 percent of all the stories in all of the issues. I hope to have the collection complete within the next ten years so I can enjoy more of those great stories. I've also written a couple of stories on my own, one of which I submitted to you a couple of years ago. I still have the rejection slip!

This is the first time I've written to Brass Tacks, but I had to do so. A little while ago, I finished one of the best stories I have read in a very long time. Stephen L. Burns wrote a really gut wrenching yarn when he penned "Look Away" for your May 2002 issue of *Analog*. It is so relaxed and so believable that you never consider the implications of nanotechnology very much. It's just taken for granted and the story moves along like it was all happening today. I hope the author wins awards big time for his efforts. He has it coming.

Thanks so much for the great work you are doing. I never thought anyone would fill John Campbell's shoes, but you are doing just that and more! Keep it up!

Fritz Owens

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* * *

Dear Dr. Schmidt,

First, I must express my continued appreciation for *Analog*. Simply the best there is. The "Science Fact" articles are usually great, fascinating and informative.

However, "A Question of Immortality" in May 2002 left me distressed. It really belonged in "Alternate View" if anywhere in your mag. Aside from my bias that we humans surely do not deserve immortality even could we achieve it, the author's favorite area of "work" is based on one of this world's most popular fallacies. This is that you can derive information about a specific from statistics derived from the general. Even assuming the sample questions listed in the article were not extracted because they reflect the "sound bytes" of the moment, and popular extremist views, it is simply ridiculous to imagine that any number of tests whose questions are based on other surveys could result in even approaching a picture of a real person.

It is like imagining that you could recreate Benjamin Franklin by synthesizing everything that's been written about him. Even if you included his own autobiography, you would surely only end up with a skewed and highly fragmented picture. Of course, it all comes down to the backbone of our problems.

There are simply too many humans on the Earth, and particularly in this country, and not enough real work to do. Too many of us, possibly including myself, are not capable of doing anything really useful, so we have to find something to do to keep us occupied. Searching for extended lifetimes or immortality by the use of soft science strikes me as one of the more foolish pastimes I've heard of. Ah, well, at least it's only foolish, not apparently harmful.

You more than made up for this flop of a fact article with the rest of that issue. Particularly "Look Away" by Stephen L. Burns, a very moving and thought-provoking story with a protagonist who learned from his world and became a better person for it. Yes, perhaps the ending was a bit too unrealistically cheerful, but a great story.

I must now beg you for relief . . . Please, please try to allow as little reflection of the 9/11 disaster to leak into *Analog* as you can possibly manage. Six months after, I am sick of hearing Americans go on and on about how upset they are. No one who does more than watch television should have been at all surprised with what happened. Of course there can be no possible justification for such acts of all-too-human barbarism, but neither can there be justification for some of the measures this country's "selected" administration has taken in response.

Please let us have something to read without continued breast-beatings on this subject.

Keep up the fine mag.

Tom Fowle

Dear *Analog*,

While Dr. Bainbridge (*Analog*, May 2002, p.47) may think that posthumous voting is a radical idea, the practice was well-established in major U.S. cities even as long ago as the nineteenth century, and without the aid of complex computer technology. Wasn't it Chicago's first Mayor Daley who said, "Once a Democrat, always a Democrat"?

Chas. H. W. Talbot

Dear Stan:

I have two problems with William Bainbridge's article "A Question of Immortality," in the May 2002 issue. First, Dr. Bainbridge completely ignores the work of cellular biologists and geneticists who are advancing toward actual physical immortality with research into the causes of aging. Human cell samples have been "immortalized" with injections of elemorase. Stem-cell research and therapeutic cloning offer the possibility of regenerating tissues *in situ*, lit-

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erally repairing or replacing organs, limbs, and other parts of the body damaged by trauma or disease.

Secondly, Dr. Bainbridge lightly skips over the fact that downloading your personality makes a copy of you, but you will die nevertheless. What do I care if there's a copy of me chatting sometime in the future if I'm too dead to enjoy it?

Downloading is not immortality. In the (pardon the pun) immortal words of Woody Allen, "I don't want to be immortal through my works; I want to be immortal through not dying."

Incidentally, this is why experienced travelers will not use matter transporters. The machine kills you! It might assemble a copy of you somewhere else, but you have been broken down into "wee little atoms," as Engineer Scott would say.

Ben Bova

The author replies...

I am grateful to Charles Talbot and Ben Bova for commenting on my article, "A Question of Immortality." Posthumous voting just illustrates how we might achieve technological immortality in a series of successive approximations, beginning today.

As coeditor of Societal Implications of Nanoscience and Nanotechnology (Kluwer 2001; PDF version at www.nano.gov), I am hopeful that the nano-bio convergence can lengthen our lifespans. Just because we can imagine something, however, does not make it possible; nor does the fact that something is possible mean it will happen soon.

The U.S. Census Bureau predicts that our lifespans will increase only about twelve years during the twenty-first century, compared with more than twenty-five years in the twentieth century. Perhaps this will be a self-fulfilling prophecy, because the Census and the National Institutes of Health belong to the same reactionary government bureaucracy. But what a horrible thing it would be if ordinary life were extended for decades! The world would become elderly. Children and the innovativeness of young minds would become annoyances rather than blessings.

Ben Bova and Stanley Schmidt (in an earlier editorial) feel technology can duplicate only superficial aspects of a person, but for me, accomplishments in the external world are more important than the private phenomenology of my current nervous system. I believe we do not have the right to immortality for personal pleasure, but only to accomplish something good for humanity.

Fifty years ago, in the pages of this magazine, James Blish suggested that the proper role of immortality was to enable interstellar flight. By whatever means we achieve immortality, we must use it to leave the Earth. Beyond Mars, we need to re-engineer ourselves for alien environments and for millennium flight times.

We should not passively wait for NIH to save us from death, but take action ourselves to earn new lives among the stars. I like the CyClone (cybernetic clone) approach, because we can begin to achieve it right now, and it offers hope we personally can explore the Universe. In a space-flight symposium at George Washington University last year, I argued that progress has stalled—it has been thirty years since I watched the last humans launch to the Moon—and that we need a radical new motivation to get going again.

In my scenario, cloning is banned on Earth, but it will be impossible to suppress private personality archiving which will grow to become a major opposition movement. People will go to Mars to escape bans on technological progress. Once Mars fills up, people will be forced to seek new homes among the stars, voyaging as CyClones within StarBase (interstellar database) ships.

My website (www.erols.com/ bainbri/qf.htm) freely offers the nine personality archiving software modules I have

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completed so far, plus literature and links to compatible projects. Currently we can archive ourselves at only very low fidelity, but scientists of the far future will logically want to resurrect the first generation who recorded themselves, and take us to the stars.

William Sims Bainbridge

Dear Dr. Schmidt,

I enjoy the "Alternate View": it often stimulates a new or deeper understanding of something I had not given much thought to previously, and sometimes encourages me in the understanding I had already reached.

However, I could not let this one pass.

Mr. Kooistra has, I feel, fallen into the trap he vehemently warns us against when he describes the "lessons not to be learned" (foot of page 91). He is quite correct in his analysis of the fallacy of the "lesson": but what has it to do with the events of September 11th? He might just as well use his energy in exhorting us not to learn from it that sunglasses do not keep out the rain! (Also true, but also not relevant.) His whole argument is a nonsequitur from start to finish, just like the argument he is attacking. He has descended to the level of his opponent and that is no way to win any argument.

As for the rest of the article: he deals with some very complex issues which I believe cannot be resolved easily or, perhaps, at all into a "right or wrong" decision. Which ever way we go (any nation, not just the USA), there are dangers to ourselves and to others. All we can do is aim for the best solution we can, and recognise that the factors which make it the best one can change over time, so maybe the best solution changes too. Once again, "Alternate View" has made me think: have I been out-thought by a master? If so, I take my hat off to Mr. Kooistra. Thank you, *Analog!*

Mary Carpenter

Dear Dr. Schmidt,

I just finished reading Jeffrey Kooistra's article "Lessions of 9/11/01" in the May edition of *Analog*. Mr. Kooistra's argument seems to be that if only we had spent more money on weapons, security, and police, then ". . . it would have saved those thousands of lives."

I am not certain of the validity of this conclusion. The U.S. spends hundreds of billions each year on security. It did not seem to make any difference in this case, nor did it in many others. Should we double, triple, quadruple this spending? Will that approach ever guarantee our security?

Trite as it sounds, the best defense against war may be peace. We need to spend those billions on producing better systems of conflict resolution. On crafting binding international agreements. On giving people the hope that they can achieve some control over their own lives with out having to use war as a means. But I fear that we will be distracted from the hard work of building a just world community and will instead focus on waging war, and so build nothing that can endure. Perhaps this is an approach which, like Mr. Kooistra's support for selective use of nuclear weapons, is currently "unthinkable." But what if the alternative is to try to endure by engaging in a war that may never end?

Scott T. Meissner

Stanley Schmidt:

I thought your May editorial was entirely apropos. You brought the several aspects of the terrorism subject together and discussed them logically in a way that I hadn't seen done to date. Thank you.

Rick Smith

Dear Stan,

An important dimension in the human behaviors discussed in your May editorial, "A Deadly Fog," is the collective actions and attitudes of societies. In World War II, the general German and Polish populations were aware of

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Hitler's persecution of the Jews. While some were saved by heroic individual acts (i.e., Schindler), there was no general outcry against the Holocaust. Closer to home during the same war, the American public generally did not oppose the imprisonment of thousands of Americans of Japanese ancestry. Crowds of Americans lined the streets of Montgomery, Alabama and South Boston, Massachusetts to hurl insults at black children enrolling in formerly all-white schools. After the September 11th attacks, news photos showed jubilant crowds applauding the terrorists in the streets of Arab countries. The terrorists were each on a suicide mission, as were the Japanese Kamikaze pilots and as are the suicide bombers in Israel; such behavior can only be explained by a supportive culture that puts "heroic" acts above individual survival. How can we understand and control these collective factors? Hah! That is the question.

John P. Aurelius

Dear Dr. Schmidt,

I have just finished (I hope) dealing with a difficult situation, and had the realization of how influential twenty years of reading *Analog* editorials can be. Specifically, being guided in how to think rather than what to think. That is, at least from my reading, the idea. To detach from an emotionally live situation in order to see what is really happening, and then determine a course of action, is a skill with which I need all the help I can get! I'm not aware of any of my formal educational experiences—and they are wide and varied—being so influential at this deeper level of thinking and problem solving. Thanks.

Alan Plummer
Australia.

PS. On editorials past: my father used to tell me of a published collection of Mr. Campbell's editorials, though I've never been able to find its title, let alone the book. Is it available anywhere? Are there, or will there be, any collections from more recent years?

John W. Campbell, Collected Editorials from Analog *was published by Doubleday in 1966. It's long since out of print, but may still be available in some used book stores. In particular, you might try the dealers listed as suppliers of back issues in the FAQ section of our website (www.analogsf.com).*

I know of no other collections of John's editorials. However, a collection of mine has just been published by Tor Books, under the title, Which Way to the Future? ■

It is not so important to be serious as it is to be serious about the important things.

—Robert M. Hutchins

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UPCOMING EVENTS Anthony Lewis

1–3 November 2002
ASTRONOMICON '02 (Rochester area SF conference) at Sheraton Four Points, Rochester NY. Guest of Honor—David Weber; Artist Guest of Honor—Ruth Thompson; Fan Guest of Honor—Forrest J Ackerman; Filk Guest of Honor—Mike Longcor. Registration—$25 until 1 September 2002, $40 at door. Info—The Rochester Fantasy Fans, Box 31701, Rochester NY 14603-1701; (585) 342-4697; email—chair@rochesterfantasyfans.org; URL—www.rochesterfantasyfans.org/astro02.html

2 November 2002
CON*CEPT 2002 (Montreal area SF conference) at Days Inn Hotel, Montreal, QC, Canada. Guests—Keith R.A. DeCandido, Larry Stewart. Registration—CAD10 until 30 September 2002, CAD15 at door. Info—MonSFFA, Attn: Con*Cept 2002 Registration, Box 1186, Place du Parc, Montreal, Quebec, Canada H2X 4A7; email—Cathy Palmer-Lister, cathypl@sympatico.ca; URL—www.monsffa.com/concept2002.html

8–10 November 2002
WINDYCON XXIX (Chicago area SF conference) at Hyatt Regency Woodfield, Schaumburg IL. Guest of Honor—Charles de Lint; Artist Guest of Honor—Lisa Snellings; Editor Guest of Honor—Shawna McCarthy; Fan Guests of Honor—Evelyn & Mark Leeper; TM—Bob Eggleton. Registration—$35 until 11 October 2002 , $50 at door. Info—WindyCon XXIX, Box 184, Palatine IL 60076-0184; (847) 677-WNDY (9639); email—info@windycon.org; URL—www.windycon.org

22–24 November 2002
ORYCON 24 (Oregon SF conference) at Doubletree Hotel Portland Columbia River, Portland OR. Guest of Honor—Susan R. Matthews; Artist Guest of Honor—Lee Seed; Editor Guest of Honor—Martin H. Greenberg. Registration—$40 until 31 October 2002, $50 thereafter. Info—OryCon 24, Box 5703, Portland OR 97228-5703; (360) 696-3821 or (503) 620-3441; email—all.wilsonsage@attbi.com or laceyax@bigfoot.com; URL—www.orycon.org/orycon24

29 November–1 December 2002
LOSCON 29 (Los Angeles area SF conference) at Burbank Airport Hilton and Convention Center, Burbank CA. Guest of Honor—David Weber; Artist Guest of Honor—Nene Thomas; Fan Guest of Honor—Patti Wells. Registration—$40 until 31 October 2002, $45 at door. Info—email—loscon29.info@loscon.org URL—www.loscon.org/loscon/29

Convention runners: If your convention has a telephone, FAX, email, or Web page URL, please let us know so that we can publish this information. We must have your information in hand six months before the date of your convention.

Convention attendees: When calling conventions for information, do not call collect and do not call too late in the evening. It is best to include a S.A.S.E. when requesting information; include an International Reply Coupon if the convention is in a different country. ■

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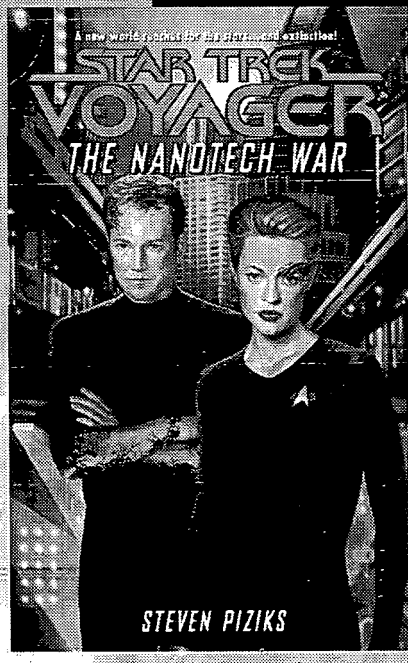

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